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ElectronicsWeek®

THE MAGAZINE OF THE WORLDWIDE ELECTRONICS INDUSTRY

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SURFACE MOUNT FEVER SPREADS

GOING BEYOND ICs AND DISCRETES
PAGE 49

How the Soviets get their hands on high technology/20

More efficient encoding schemes give mass storage a boost/55

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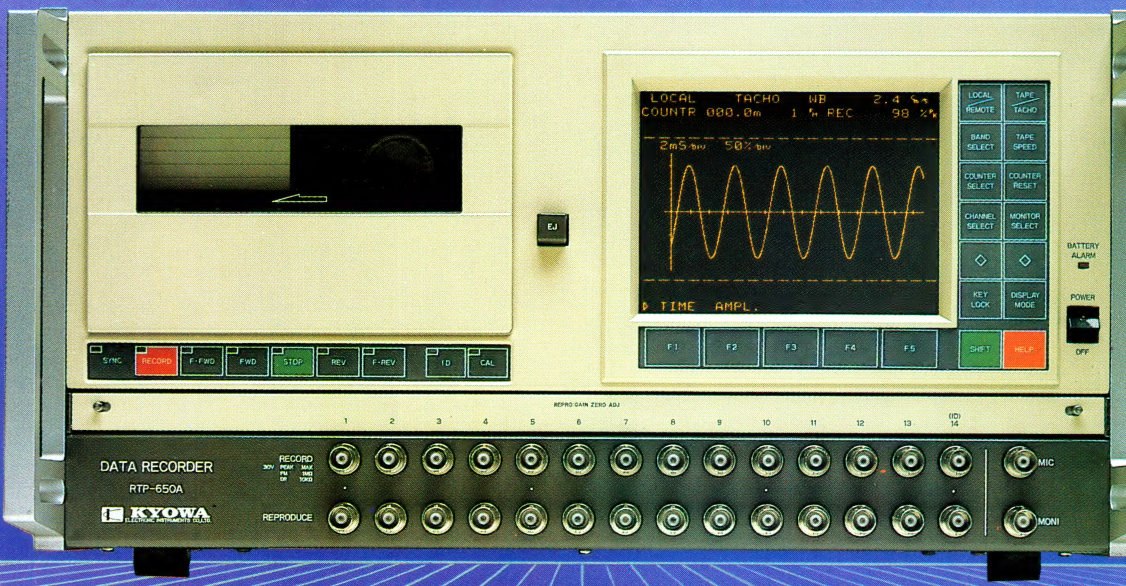

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International edition

UP FRONT

Next ElectronicsWeek

Flexible modular approach brings down cost of ATE

For manufacturers of semiconductors and large electronic systems, dedicated automatic test equipment is a necessary investment. But ATE can be devilishly expensive—in-circuit functional testers can range to well over $100,000—effectively closing it off to thousands of small-systems and subsystems manufacturers that must test small quantities of different products. They have relied mainly on manual testing. But a new approach, in which modules are interchangeable, opens the ATE closet for them. Flexible ATE can be used for such applications as field service, low-volume production test and rework, and engineering design. Read about it next week in *ElectronicsWeek.*

Fiber-optic technology is on a roll

When optical fibers burst on the scene, the technology was attractive to designers because of its promise of huge information-handling capability. That attraction has not diminished, even though optical technology has not overtaken coaxial systems in that respect. But what fiber has demonstrated, and what is driving the trend toward future universal use of optical fibers in communications systems, is its inherent ability to lower installation and maintenance costs. Learn about it in the next issue of *ElectronicsWeek.*

Looking ahead in ElectronicsWeek

Spring means it's time for Electro again

As the Northeast begins to show signs of moving into its spring dress—budding trees, greening grass, and blooming tulips—those signs also herald the approach of the annual Electro show. Scheduled to take place this year in New York, it will present its usual potpourri of attractions for the engineer. See a future *ElectronicsWeek* for a preview.

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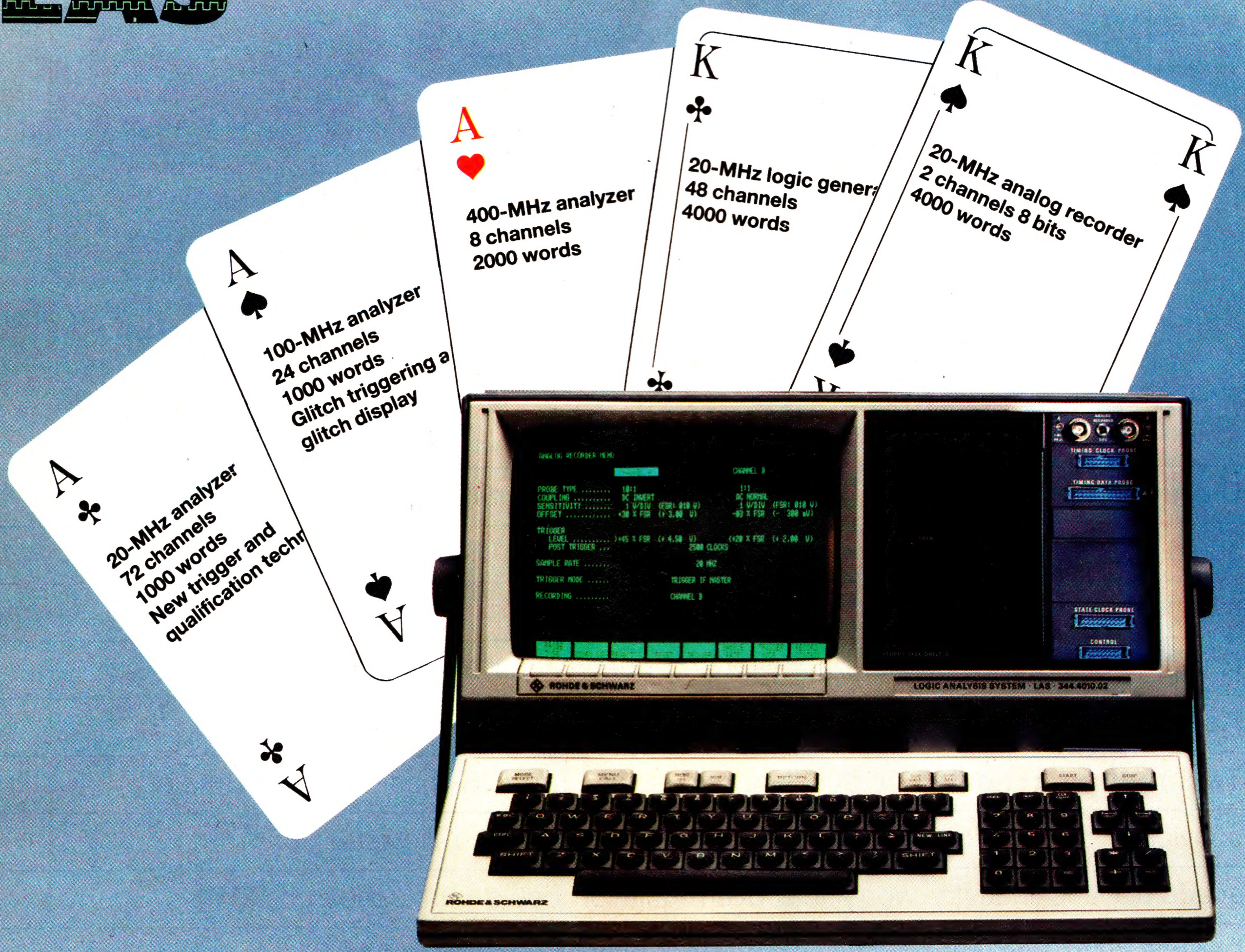

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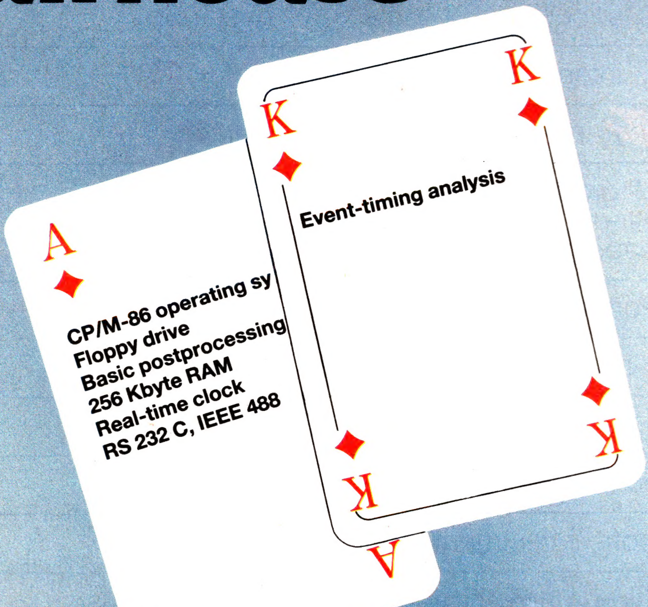

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ElectronicsWeek

THE VOICE OF THE INDUSTRY, HEARD EVERY MONDAY

TECHNOLOGY SPY STORIES

U.S. cuts flow of high-tech info to Soviets/20

Technology Around the World

Circuit Design LSI in 3-d coming soon. Silicon-on-insulator circuits could be on the market by 1990, 2-d versions within the next two years—well ahead of what had been expected **16**

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Technology Transfer Of scholars and spies. The U.S. has secured a major conviction on the illegal export of high technology to the Soviets. But academia and industry worry that overregulation could curb research **20**

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Computers Minicomputers shed their high-end image. As the minicomputer market comes of age, companies are shifting their product emphasis from hot performance to family ties and compatibility **32**

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Fabrication Technology Components for surface-mounted assembly arrive. Reacting to predictions of explosive growth in the use of surface-mounted devices, components makers are starting to churn out a variety of switches, capacitors, and relays, along with discrete semiconductors and ICs **49**

Disk Recording Mass storage gets new boost. Using more efficient encoding schemes, designers of Winchester disk drives are increasing the number of bits per inch. This greater bit density yields disks with higher capacity at little or no extra cost **55**

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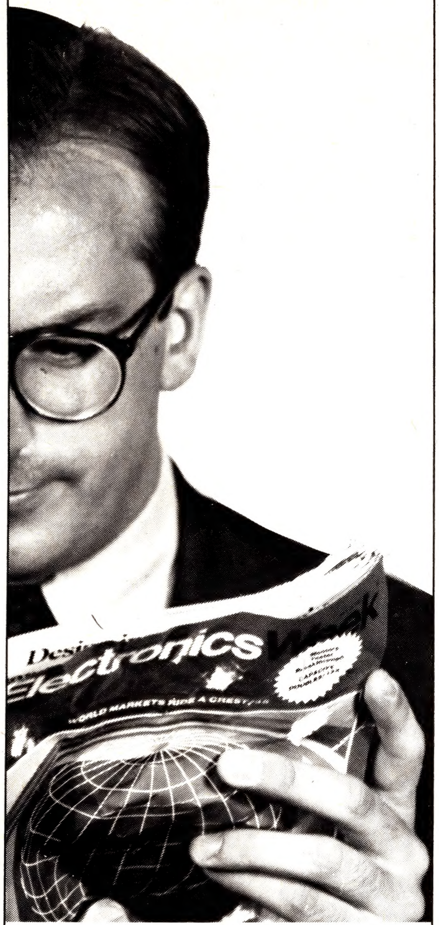

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Meetings

First International Symposium on Automated IC Manufacturing, Electrochemical Society (Asyst Technologies Inc., 46309 Warm Springs Blvd., Fremont, Calif. 94539), Royal York Hotel, Toronto, Ont., Canada, May 13-17.

Electroworld '85, Electrical Representatives Club of Denver and Instrument Society of America (Minetta A. Miller, Electroworld, 909 17th St., Suite 418, Denver, Colo., 80202), Currigan Exhibition Hall, Denver, May 14-15.

1985 Symposium on VLSI Technology, Japan Society of Applied Physics and IEEE (Yoshio Nishi, Toshiba Corp., 1, Komukai, Toshiba-cho, Saiwaiku, Kawasaki 210, Japan), Kobe Convention Center, Kobe, Japan, May 14-16.

Digitech '85, Instrument Society of America, ISA's District One (P.O. Box 12277, Research Triangle Park, N.C. 27709), Bayside Exposition Center, Boston, May 14-16.

Fourth Test & Measurement World Expo, Test & Measurement World Expo (Meg Bowen, Conference Director, Test & Measurement World Expo, 215 Brighton Ave., Boston, Mass. 02134), San Jose Convention Center, San Jose, Calif., May 14-16.

Electromagnetic Energy Policy Alliance 1985 Meeting, Electromagnetic Energy Policy Alliance (EEPA, 1800 M St., N.W., Washington, D.C. 20036), Hotel Intercontinental, San Diego, May 14-17.

Automan '85—Third European Automated Manufacturing Exhibition and Conference, British Robot Association (IFS Conferences Ltd., 35-39 High St., Kempston, Bedford MK42 7BT, England), National Exhibition Centre, Birmingham, England, May 14-17.

Asia Telecom '85, Telecommunication Authority of Singapore *et al.* (Conference and Exhibition Secretariat Pte. Ltd., 6-E Mount Sophia, Singapore 0922, Singapore), Hyatt Regency Singapore, May 14-18.

Carnahan Conference on Security Technology, IEEE (Cheryl Banks, Office of Engineering—Continuing Education, University of Kentucky, Lexington, Ky. 40506-0043), Carnahan House, University of Kentucky, Lexington, May 15-17.

1985 Chapel Hill Conference on VLSI, National Science Foundation (Department of Computer Science, New West Hall 035 A, University of North Carolina, Chapel Hill, N.C. 27541), University of North Carolina, Chapel Hill, May 15-17.

Building Profitability into Electronic Information: The User Generation, Information Industry Association (IIA, 316 Pennsylvania Ave., S.E., Suite 400, Washington, D.C. 20003), McCormick Center Hotel, Chicago, May 15-17.

Telemarketing/West, Telemarketing East/West Inc. (Peter J. Carroll, President, Telemarketing East/West, P.O. Box 3315, Annapolis, Md. 21403), Convention Center, Anaheim, Calif., May 15-17.

Factory Mechatronics '85, Osaka International Trade Commission (H. Atsushiba, Japan Trade Center, 1221 Avenue of Americas, New York, N.Y. 10020), New Osaka International Fairgrounds, Osaka, Japan, May 15-21.

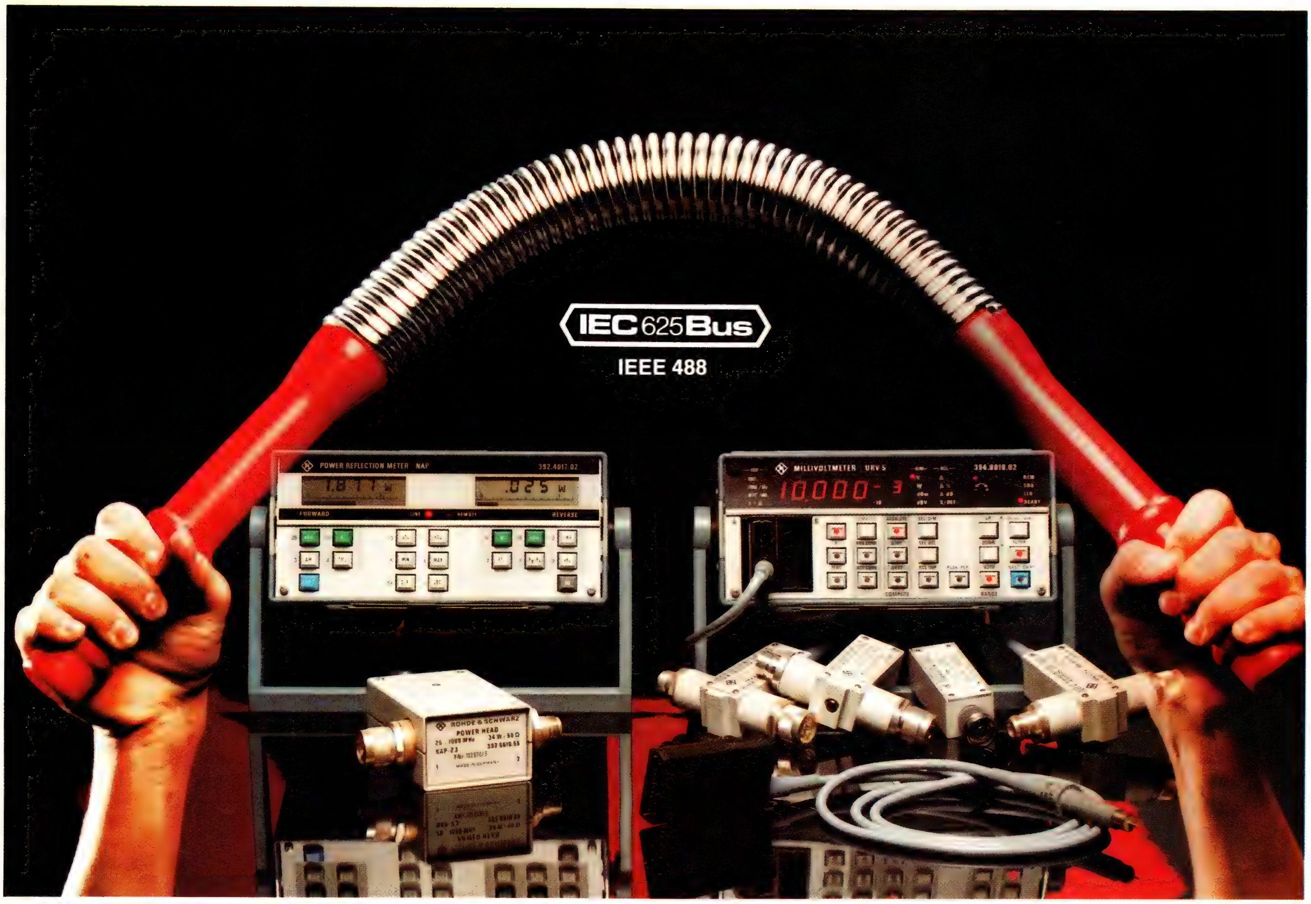
Cadam User's Exchange Conference, Cadam User's Exchange International (CUE Administrative Offices, P.O. Box 3684, Torrance, Calif. 90510), Marriott Hotel, New Orleans, May 19-24.

Seminars

CADD/CAM: Management, Evaluation, and Implementation, Technology Transfer Institute (741 Tenth St., Santa Monica, Calif. 90402), Marriott Crystal City, Arlington, Va., May 13-15.

Relational Data Base, Technology Transfer Institute (741 Tenth St., Santa Monica, Calif. 90402), Copley Plaza, Boston, May 6-8; Los Angeles Marriott, Los Angeles, May 13-15.

Voltage Power Reflection



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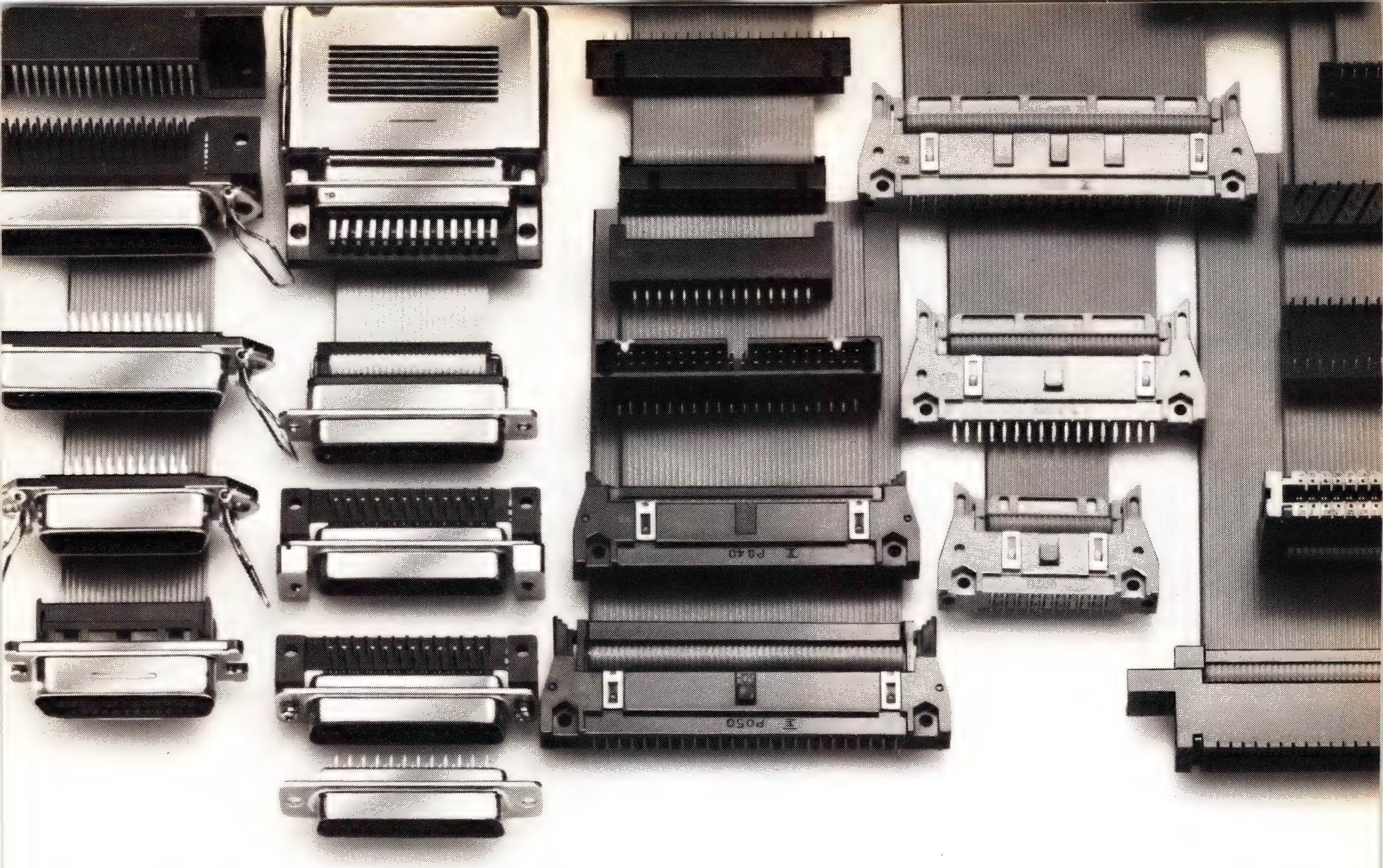

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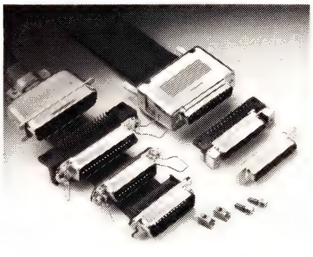

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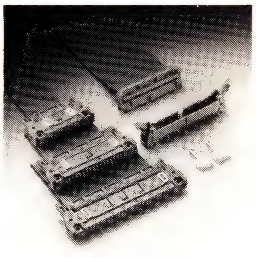

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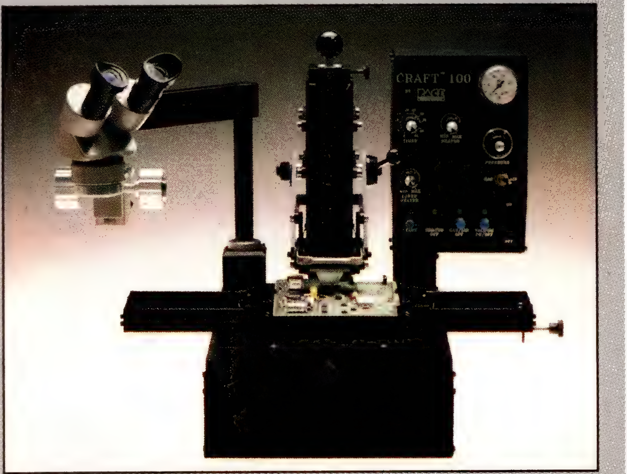

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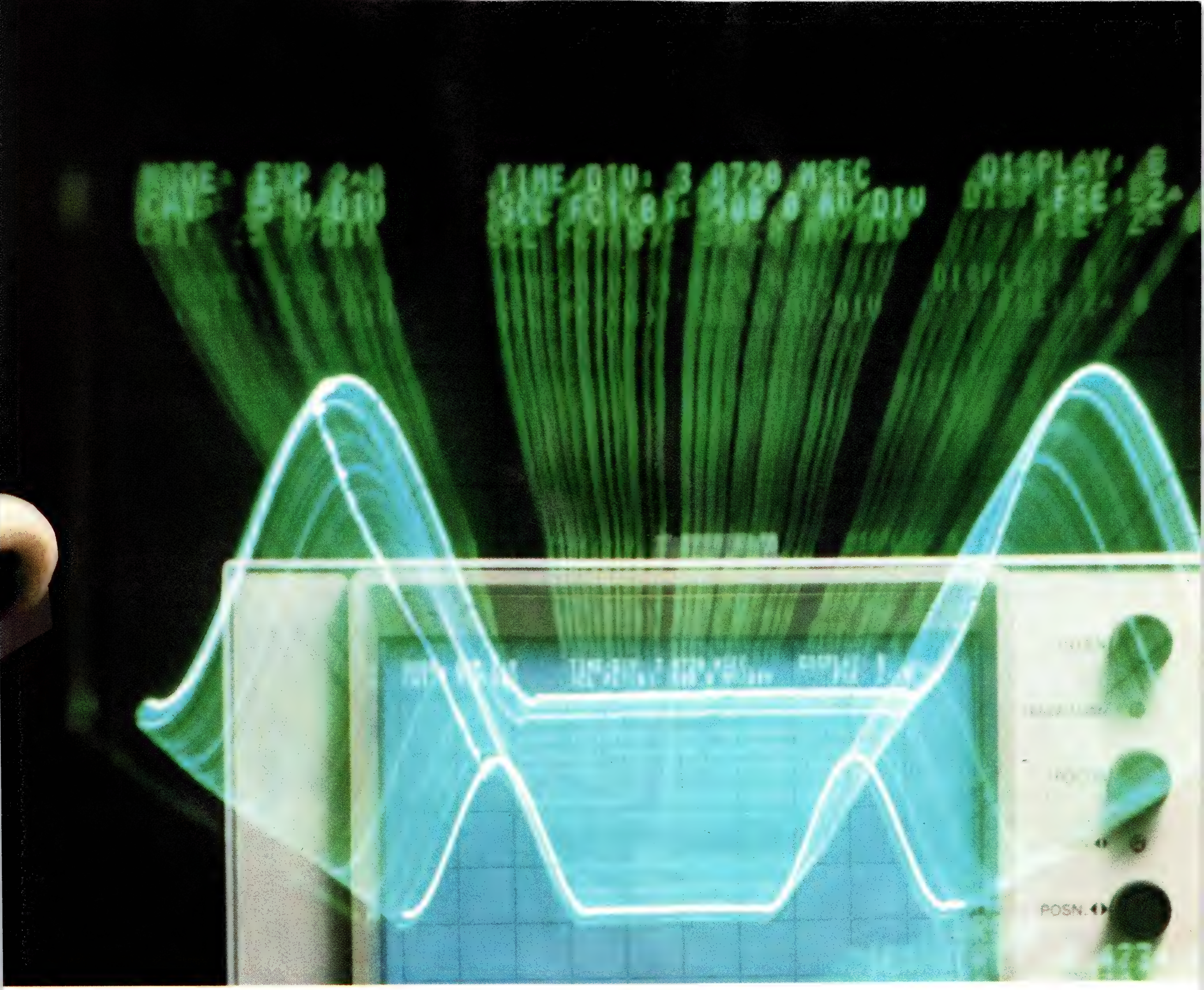

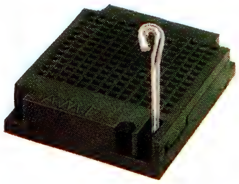

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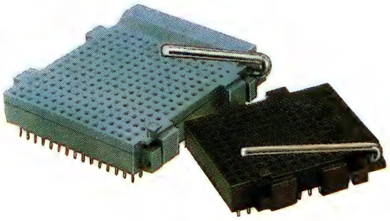

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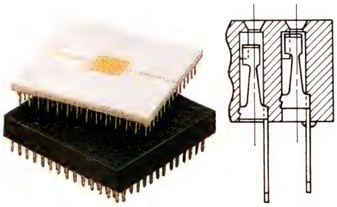

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DENELCOR AIMS AT LOW-END MARKET

Believing that its parallel-processing supercomputers are no longer limited just to academic and government research, Denelcor Inc. is repositioning itself to compete in the broad commercial market now served by more conventional superminicomputers and scientific mainframes. To do that, Denelcor has placed a $995,000 price tag on a new low-end configuration of its Heterogeneous Element Processor system, known as HEP1. Prior to the availability of this new 1502 model, Denelcor's smallest systems sold for about $2 million each and were delivered mostly to government laboratories. Now the Aurora, Colo., company has a complete line of commercial HEP1 configurations, ranging from the 1502 with a single process-execution module (PEM) to an eight-PEM system selling for $7,130,250.

Each highly parallel PEM can execute the equivalent of 16 million instructions per second. That makes the low-end 1502 about 16 times more powerful than a Digital Equipment Corp. VAX-11/780 equipped with a floating-point accelerator, claims R. David Lowry, Denelcor's manager of market development. "What you see with the new line is our reaction to going commercial," he adds. Lowry participated in a recent sales meeting at the University of Oklahoma in Norman, where the firm unveiled its new marketing strategy and computer line.

Over the past two years, Denelcor has shipped HEP1 systems totaling $23 million to six customers, including four U.S. agencies—the Los Alamos National Laboratory, the Argonne National Laboratory, the Army's Ballistics Research Laboratory, and the Department of Defense. Early commercial sales have been made to Messerschmitt-Boelkow Blohm GmbH of West Germany and Showa Denko K.K. of Japan, but Lowry believes 1985 will be the commercial turning point for the firm and its highly parallel-processing, multiple-instruction, multiple-data (MIMD) computer.

Denelcor earned $202,000 in the final three months of 1984, its second quarterly profit since switching from the analog-scientific-computer business in the late 1970s to pioneering the MIMD architecture. Corporate officials hope the new commercial thrust in 1985 will give Denelcor its first annual profit in more than five years. In addition, HEP2—Denelcor's next-generation system, which can execute more than 12 billion instructions per second—is firmly on track, with a prototype expected to be running later this year.

But it is at the low end of Denelcor's offering that company managers are looking for major inroads into such commercial markets as image processing, flight simulators, oil exploration, computer-aided design, geometric modeling, and integrated-circuit design. Until now, software programming was believed to be Denelcor's biggest hurdle. However, Lowry believes those worries are being assuaged by HEP1's track record with university and laboratory researchers and a new real-time parallel-processing version of AT&T Co.'s Unix operating system. The first copy of HEP/UPX was installed late last month at a customer site. Denelcor is offering a three-day training course to prepare programmers for software development on parallel HEP1 systems. To address existing application software, the firm has launched three separate projects to create serial-to-parallel code compilers. ☐

Boeing Computer Services enters retail software market

The sleeping giant called Boeing Computer Services is stirring (see p. 19). Concerned for years mostly with meeting the internal computing needs of its parent, Boeing Co., as well as the needs of other large corporations and the federal government, the Bellevue, Wash., division made a market-related announcement last week that was worth noting. Its Software and Education Products Group unveiled a three-dimensional spreadsheet, called Boeing Calc, that is similar to Lotus Development Corp.'s 1-2-3 program for use on microcomputers, multiuser systems, or mainframes. The version for IBM Corp. Personal Computers and compatibles is not limited by memory and costs $399, compared with Lotus's list price of $495. Boeing Computer Services hopes to make a handy profit on Boeing Calc and other such retail excursions, especially because it has already recouped its initial development costs by first using the programs internally. ☐

South Korea increases electronic exports to China

South Korea, which has no diplomatic relations with the People's Republic of China, is nonetheless increasing its exports of electronic products to that country through third-party traders in Hong Kong. In this fashion, close to $2 million worth of telecommunications components, mostly for telephones, were shipped to China from South Korea last year, and an electronics executive in Seoul reveals that his company sold more than 600,000 integrated circuits and other components—mostly for color TV sets—in the first quarter of 1985 alone. ☐

Mostek lays off assembly workers in Malaysia

As further evidence that the effects of slow semiconductor sales are spreading, Mostek Corp. has begun to lay off workers at its two chip-assembly plants in Malaysia. About 600 workers are being furloughed at the Penang assembly and testing facility, while 400 jobs are being cut at the Kota Bharu assembly plant. Prior to the layoffs, Mostek employed 2,600 people in Penang and 700 in Kota Bharu. In the U.S., the MOS manufacturer earlier reduced its wafer-fabrication workforce by 620, mostly because of depressed sales of random-access-memory chips. ☐

Ricoh to sell AT&T computers in Japan

AT&T Co. reached a nonexclusive agreement with Ricoh Co. under which Ricoh will distribute AT&T's 3B minicomputers in Japan. The agreement followed a major purchase by the U.S. company last December of Ricoh's high-speed facsimile copiers for sale in the U.S. by AT&T Information Systems. AT&T is also in the final stages of negotiating an agreement with Olivetti Japan to distribute the 3B machines there. The U.S. firm says it looks upon the two agreements as complementary because Ricoh is strong in the small-business market and Olivetti has experience in the financial and agricultural markets. In the meantime, AT&T says that its negotiations with Japan ENS Inc. (a consortium made up of 16 Japanese companies) to set up a value-added network based on the technology and hardware of AT&T's Net 1000 system are moving rapidly toward a conclusion. AT&T has already shipped packet-switching equipment to Japan ENS for initial testing as part of the VAN project. ☐

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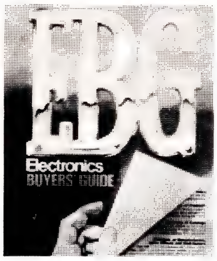

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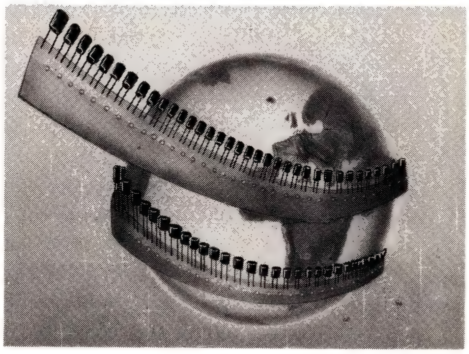

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LSI IN 3-D COMING SOON

SOI circuits should be available by 1990, 2-d versions in two years, say experts after disclosures at Tokyo conference

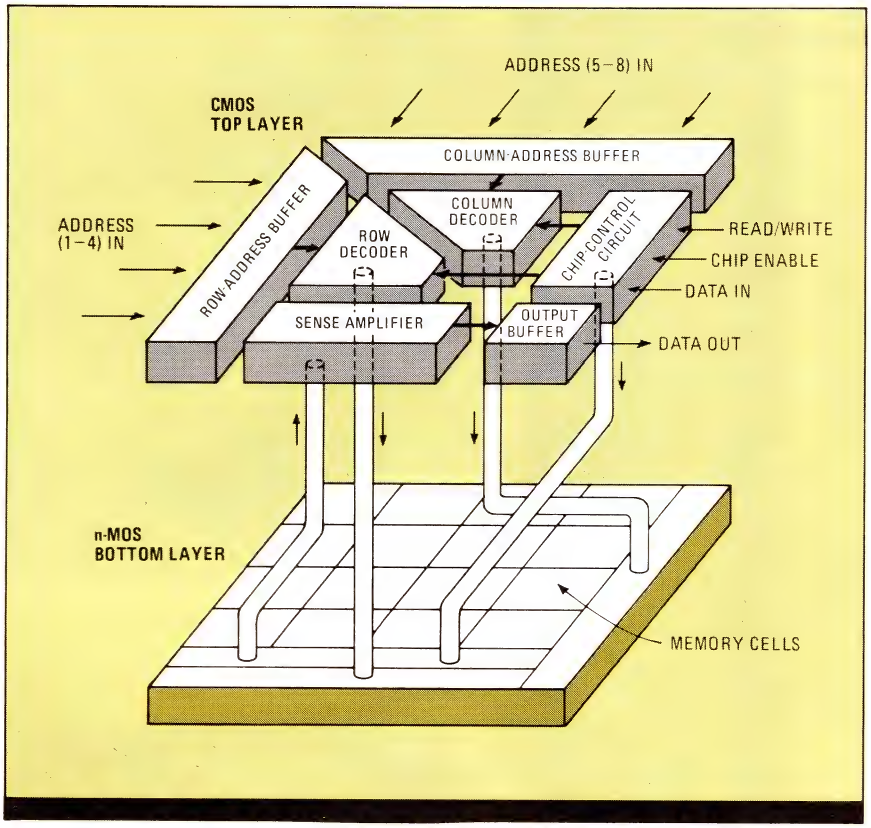
☐ *by Charles L. Cohen*

Tokyo

Experts in three-dimensional large-scale-integration research are pushing forward their timetables for widespread availability of two- and three-dimensional silicon-on-insulator circuits. They say that 2-d circuits are likely to be available within the next 24 months and 3-d versions in the early 1990s.

The optimism was prompted by papers delivered here at the Japan Society of Applied Physics conference. Among those predicting the early appearance of circuits was Nobuo Sasaki, a leader of the SOI group at Fujitsu Ltd. in Kawasaki. Seconding the motion was Yoichi Akasaka, manager of the VLSI Process Technology Group at Mitsubishi Electric Co.'s LSI Research and Development Laboratory in Itrami.

Akasaka's team revealed perhaps the most significant work: an experimental 1.1-kilogate array. The array is fabricated in laser-recrystallized silicon on a silicon dioxide insulating layer. Significantly, its reported performance approaches that of CMOS circuits fabricated on standard substrates. Other papers on gate arrays, 3-d circuits, and SOI technology made it clear that the Mitsubishi experiments are not isolated.



From every side. A three-dimensional 256-by-1-bit static RAM from Mitsubishi has an n-MOS bottom layer and a CMOS top layer. Cells on the 2.6-by-1.9-mm^2 chip measure 50 by 70 μm^2.

Mitsubishi's work—supported by Japan's Future Electron Device Project under the Research and Development Project of Basic Technology for Future Industries [*Electronics,* Sept. 8, 1983, p. 94]—resulted in an identical laser-recrystallization method. Integrated-circuit fabrication technology was used to deposit a 500-Å nonreflecting thin film of silicon nitride on the polysilicon layer. Then an etch, using standard patterning technology, left a 5-μm-wide silicon nitride stripe with a center-to-center pitch of 15 μm. A raster scan with a 20-W beam tracing a line 100 μm wide with an overlap of about 30 μm recrystallizes the layer.

Sinusoidal heat. The resulting heat distribution in the layer is nearly sinusoidal, with the highest temperature under the nonreflecting stripes and minimum temperature between them. Unseeded recrystallization begins in the region between the stripes and proceeds to the region under the stripes as the surface cools down. Those regions between the stripes that were first recrystallized become high-quality single-crystal silicon that is suitable for circuit fabrication.

The new gate-array design appears as 13 rows of 132 basic cells arranged in two columns, with three basic cells of two transistors equal to a two-input NAND gate, for a nominal size of 1.1 kilogates. There are also 66 input/output gates arranged on the periphery of the 5.37-by-4.90-mm chip. It has 7,524 transistors. Chips are fabricated in a 0.5-μm-thick recrystallized silicon film overlying a 1.1-μm silicon dioxide layer by a CMOS process with 3-μm design rules. Gate widths are 52 μm. Two levels of aluminum interconnection form practical circuits.

Two wafers. The array has been fabricated on both SOI and substrate wafers. The gate-oxide thickness of the transistors is 400 Å for the substrate devices and 600 Å for the SOI devices. Because of the thicker gate oxide of the SOI transistors, approximately 30% longer propagation delay is realized in the basic inverter circuit. But an 8-by-8-bit parallel multiplier fabricated on both types of array shows approximately the same critical-path propagation time—145 ns for low-to-high transition and 120 ns for high-to-low transition.

Because the wiring capacitance of both first- and second-level aluminum is only about 60% that of the substrate devices, equivalent performance for the SOI array, despite its slower inverter circuits, is possible. It has been estimated that the SOI inverters with same gate-oxide thickness would be 10% faster than with substrate devices. This should significantly increase the speed of completed circuits because the benefits of reduced interconnection capacitance would still be obtained.

A 10-bit linear image sensor fabricated as a two-level circuit uses a linear array of 10 photodiodes fabricated on the SOI layer and switching circuits fabricated on the substrate. Three shift registers control three separate MOS switches for each photodiode. The photodiodes are charged to power-supply voltage, and the reported discharge is proportional to the brightness of the document being scanned.

One switch charges the photodiode to power-supply voltage; a second connects it to an amplifier-driving signal line; and a third discharges the input to an amplifier before the next photodiode is connected. The designers claim that the sensitivity of the photodiodes fabricated in the SOI layer is comparable to the same size elements fabricated directly on a bulk chip.

Three levels. The same group also built a three-level circuit with operating transistors on all layers and with through-holes between the layers. The substrate has n-channel devices with 2-μm design rules; the second layer has CMOS transistors with 3-μm design rules; and the top level has n-channel transistors with 3-μm design rules. Interconnections on the substrate layer are doped polysilicon; those on the second layer are molybdenum silicide of the type used in dynamic random-access-memory word lines for low resistivity.

NEC Corp.'s Microelectronics Research Laboratories and Fundamental Research Laboratories in Kawasaki use a different method to get a temperature profile suitable for laser annealing of polycrystalline silicon on a silicon dioxide substrate. The wafer is scanned by what is termed a split laser beam. The temperature profile along the line being scanned is like an upside-down W.

Recrystallization of the area in which transistors are to be fabricated starts at the lower temperature region in the center, and good crystal quality extends to the region of the two peaks, 15 μm apart, where it is upset by recrystallization advancing from the outside.

Matsushita's three-level circuit was made using two levels of laser-beam recrystallized SOI on a semiconductor substrate

Several types of two-layer 3-d devices have been made. Transistors can be laid out and fabricated in a conventional manner on the substrate. But in the SOI layer, the channels of transistors must be arranged linearly along the direction of the high-quality recrystallized stripe.

CMOS circuits were built with n-channel transistors in the substrate and p-channel transistors in the SOI layer. SOI transistors made with a gate-oxide thickness of 400 Å, a gate length of 4 μm, and a gate width of 7 μm have a threshold voltage in the range of −1.0 to −1.3 V and a drain leakage current of less than 1 pA for a gate voltage below 0.6 V.

Actual CMOS circuits fabricated include a J-K flip-flop, a 53-stage ring oscillator, and a 32-bit dynamic shift register. Including buffers added for test purposes, the dynamic shift register has a total of 480 transistors. The shift register operates at frequencies as low as 100 Hz and up to 600 kHz at a supply voltage of 5 V. Operation of the circuit with 480 transistors shows high yield, while ability to operate down to 100 Hz confirms low drain leakage current. Other tests show only small variation in the gate threshold voltage.

Fujitsu reported on work at its Kawasaki lab that yielded three-level CMOS static RAM in a substrate and two successive SOI layers

Decreasing cell size. Fujitsu's IC Development Division in Kawasaki reported fabrication of a three-level CMOS static RAM in a substrate and two successive SOI layers. The cross-coupled inverters in the basic cell consist of two p-channel transistors on the substrate and two n-channel transistors on the first SOI layer. Completing the cell are two n-channel transfer-gate transistors on the second SOI layer.

Fujitsu engineers say that the addition of the third layer significantly decreases cell size. When built with 1.5-μm design rules as a single-layer device, the cell occupies an area of 360 μm^2. The area decreases to 302 μm^2 for a two-level version and to 162 μm^2 for the three-level version.

Matsushita Electric Industrial Co.'s Semiconductor Research Center in Osaka described a three-level circuit using amorphous silicon and laser-beam recrystallized SOI on a semiconductor substrate. It includes eight optical sensors on the amorphous-silicon top layer, CMOS circuits on the SOI layer that convert the sensor signal to zero or one, and eight CMOS SRAMs on the substrate. Matsushita's work was supported by the Future Electron Device Project. ☐

NEW SYSTEM AIDS SPACE SHUTTLE

Lindau, West Germany

If the launch this week of the space shuttle Challenger from Cape Canaveral is a success, a large measure of the credit will go to radar equipment developed here. Launching will take place only after the radar, recently installed at the Cape, has detected no severe clear-air turbulence, high-altitude winds, or other atmospheric phenomena potentially hazardous to the launch. The radar will also look out for such conditions when the space shuttle lands.

Clear-air turbulence usually accompanies jet streams. These currents of fast-flowing air, which are particularly frequent over Florida, can attain velocities of more than 180 mph. Thus they pose a threat to space vehicles during launch and especially during their powerless descent.

The German atmospheric radar, called Sousy (for sounding system), was developed at the Max-Planck-Institute for Aeronomy in this small town in central Germany's Harz Mountains. The installation at the Cape is leased and operated by Radian Corp., Austin, Texas, which has acquired the rights to build the system under license.

Missing link. Sousy uses remote sounding to keep tabs on dynamic events in the atmosphere from the ground to altitudes of about 100 km. "It thus links the sciences of meteorology and aeronomy by new, so far neglected, investigations into the physical processes taking place in the atmosphere's lower and upper layers," explains Jürgen Klostermeyer, the Sousy project leader.

Because of a lack of adequate measuring techniques, knowledge of what is happening in the atmosphere has many gaps, says Gerhard Schmidt, a member of Klostermeyer's team. Planes reach an altitude of only 25 km or so, while balloons take a long time to reach the upper levels and tend to drift away. And high-altitude sounding rockets are expensive and take only a short snapshot of the extremely dynamic processes in the atmosphere.

With its remote soundings, Sousy fills those gaps. Other radar systems can look into the upper reaches of the sky, but none is as advanced as the German system for detecting clear-air turbulence and other atmospheric phenomena.

A Sousy system put up here by Max-Planck researchers consists of an array of 196 Yagi antennas, which send out electromagnetic waves of about 50 MHz in the very high-frequency range. The phased-array antennas radiate the energy straight up and at different angles to obtain vertical and horizontal components and thus obtain a three-dimensional profile. The antennas handle both transmission and reception.

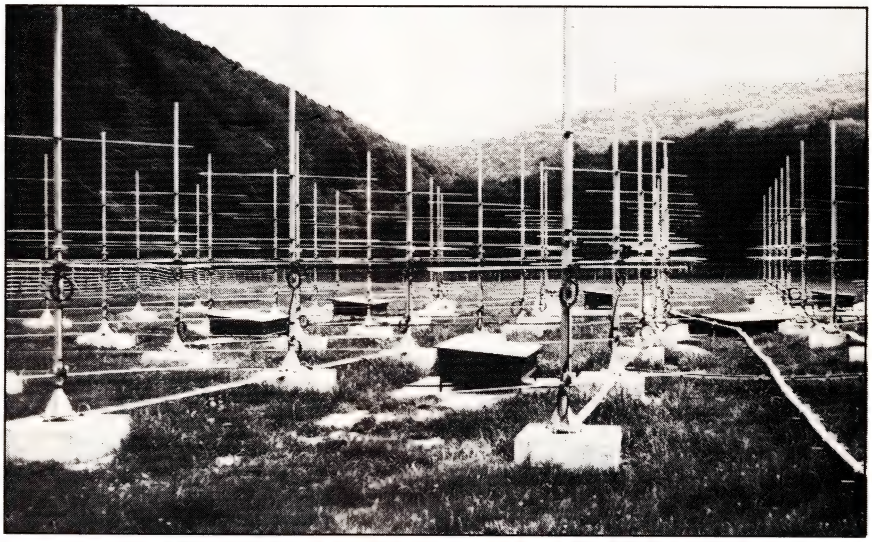
When it encounters air turbulences, the pulsed energy scatters, with a tiny fraction reflected back to earth. The radar echoes and their shift in frequency, a result of the Doppler effect, give precise information about different atmospheric phenomena, their altitude, and speed. A computer evaluates the radar-generated data and provides a printout.

The antenna array occupies an area in the valley of about 3,150 m^2 (roughly 28,000 ft^2) and the peak pulse power for the whole array is 600 kW. Each antenna is a four-element Yagi with a gain of 31 dB. Polarization is linear, and the antenna control is continuous.

Depending on the pulse's length, frequency, and repetition rate, Sousy provides a complete profile of air movements at levels from 500 to 30,000 m with an accuracy of 150 m. It registers meteorological structures such as high- and low-pressure areas, storms, weather fronts, and thunderstorms and also global air circulation, atmospheric tides (diurnals and semidiurnals), and lee waves behind mountains. Many of these phenomena are difficult to detect with conventional methods.

Unlike this installation, the system at Cape Canaveral is mobile, with transmitting, receiving, and data-processing equipment housed in a van. With its 132 easily installed and dismantled Yagi antennas, the system gives a complete wind profile over the Cape up to 20 km on a minute-to-minute basis and in 150-m-thick slices. Its peak power is 200 kW.

To improve Sousy, Max-Planck researchers plan to couple the radar to a laser, so that at altitudes between 30 and 90 km the atmosphere's density and temperature distribution can be measured. **–John Gosch**



Sousy goes abroad. A mobile version of the Sousy (for sounding system) stationary atmospheric radar system, shown in West Germany, will aid in the U.S. space shuttle's launch.

BOEING PUSHES BNA STANDARD

Bellevue, Wash.

Boeing Computer Services, a division of Boeing Co., has taken as its mission the Herculean task of imposing international standards on a recalcitrant hardware community. It seems to be making significant progress using the most persuasive argument of all—that it will not buy from vendors whose products don't conform to standard protocols.

"We've been working on this for seven years," says Terry Milholland, manager of the Network Applications Development Support Center for Computer Services' Advanced Technology and Applications Division. He says that at the start of the project, called Boeing Network Architecture, or BNA, the idea was to "integrate vendors through their own architectures." The point was to have the company's expensive computer equipment—estimated to be worth about $500 million—work together across Boeing's vast geographical and organizational boundaries.

Milholland says that all vendor companies had to agree to develop products based on the open-systems interconnection reference model (OSI), or at least offer migration paths through software while hardware was being developed. Some firms already have migration products on their shelves.

"Most of them were responsive right from the start, but we had to shake 'em," says Milholland. Rules are strict for vendors that have been selected. Qualifying requires an intense, four-tiered evaluation that some companies, even those with good reputations, cannot pass.

If a company wants to develop a product outside the BNA-OSI umbrella, says Milholland, Boeing Computers' Architecture Management Council must approve the procedure and the firm must furnish its plan, with dates, to come back into BNA.

This attitude had analysts who attended a recent tour of the division's facilities chuckling at any mention of IBM Corp.'s developing products to OSI standards. The computer giant has refused to participate in any standardization process that might break its stranglehold on the market.

But Boeing, which has millions of dollars invested in IBM equipment, takes Big Blue's involvement seriously. Boeing believes IBM is committed to the OSI process because of its participation in setting token-ring protocols for local-area networks and its work with General Motors Corp. on the Manufacturing Automation Protocol, or MAP [*ElectronicsWeek*, Dec. 17, 1984, p. 20]. Through necessity, Boeing has based its present BNA design on the migration of IBM to OSI standards, since at the moment IBM's Systems Network Architecture is the de facto standard.

"But BNA is more generic than SNA or other layer protocols," says Milholland. The plan is to migrate SNA and its installed base toward providing gateways to OSI through specific applications by 1990.

Because of the ability to provide such gateways, some company executives don't really care whether IBM chooses to play ball with OSI. "The SNA strategy can stay on as long as natural," says Sheldon Blauman, manager of network architecture planning for the Advanced Technology Applications Division of Boeing Computer Services. "Meantime, we'll implement OSI a vendor at a time. Eventually we won't need IBM or SNA at all."

Boeing's showings. Laurie Bride says Boeing is arranging a demonstration of OSI at Hanover '86 in addition to the one already scheduled for Autofact.

Work with NBS. Boeing Computer is working hard to effect that independence. It is heavily involved in the National Bureau of Standards' ongoing OSI Implementors Workshop, as well as in pilot projects such as the one in Gaithersburg, Md., where an NBS facility is manufacturing small parts for the Navy with robots. It is also working with the NBS on its upcoming Osinet, which is an international research network to serve as a testbed for developing and testing OSI protocols selected by workshop attendees.

Laurie Bride, manager of networking technology for the Network Services Group of Boeing Computer, says Osinet will be on line in early 1986. Such companies as Siemens, Olivetti, and Wang have shown interest in getting standard protocols adopted in Europe.

Boeing is putting together a demonstration for Autofact 1985, the trade show for companies that automate factories, to be held in Detroit this November. In addition, an OSI test facility located here will beta test the Autofact demonstration.

"We're bringing up a lab and certifying protocol implementations for vendors on our side of the network—in engineering and office automation," says Bride. "Most code and test scenarios from the NBS are in the public domain, and our VAX is identically configured to DEC and NBS." **–Denise Caruso**

OF SCHOLARS AND SPIES

U.S. secures major conviction on illegal export to Soviets as industry and academia fend off heightened restrictions

by Alexander Wolfe

The conviction of a prominent businessman charged with engineering an intricate scheme of below-board purchases and phony front companies worthy of a John Le Carré novel will likely send reverberations through the corridors of academia and industry. There, a debate over what one ex-government official called the "hemorrhage outflow" of U.S. high technology to the Soviet Union is currently raging.

The case may give timely new ammunition to those calling for increased restrictions. At the same time, it will no doubt heighten opponents' concerns that, with overregulation, the U.S. may wind up shooting itself in its technological foot.

Using shell corporations in Vienna and Lichtenstein, D. Frank Bazzarre, a Maryland engineer, funneled $6.5 million worth of semiconductor fabrication and test equipment to the Soviet Union. On March 19, he was convicted on export law violations charges and currently awaits sentencing. Bazzarre faces up to 15 years in prison and up to $5 million in fines.

Under the table. The goods were acquired through Bazzarre's Technics Inc., supposedly a firm engaged in building semiconductor fabrication equipment for domestic use. Then, concealed in shipping crates variously marked "mechanical goods," "alignment bench," and "positioning unit," the gear was smuggled to Europe. Bazzarre's front companies completed the shipment eastward.

Bazzarre purchased much of the equipment from TRE Inc. (formerly Electromask) of Woodland Hills, Calif. He bought two model 2500 Crisscross pattern-generator and photo-repeater systems. Subsequent purchases from TRE included spare parts, along with retrofit kits and a conversion package.

Authoritative sources told *ElectronicsWeek* that the case came to light when one supplier, Watkins-Johnson Co., became suspicious. The company tipped off government officials after Bazzarre, who had purchased a Watkins-Johnson model 1450 bubble-memory tester, told it not to send a field engineer to set up and test the equipment.

As a result of the case, illegal exporters are said to be running scared. However, Bazzarre's escapades may also increase the concerns of legitimate companies, who fear they will be subjected to burgeoning restrictions. The Department of Commerce is considering tightening the rules for distribution licenses, under which manufacturers can ship multiple products without having to reapply for a new license for each one. Of the $20 billion of manufactured exports, 15% are shipped under these licenses.

More notably, a revamped Export Administration Act is slated to come before Congress this session. In limbo after expiring last year, the act was the major weapon in the war against the outflow of critical high technology.

The legislation has been the sub-

ject of much bureaucratic wrangling, as the DOD and Commerce have each fought to secure greater regulatory turf. Export control continues under a stopgap presidential directive, pending the passage of a new export administration act.

One harbinger, if the DOD were to receive the power to regulate exports it has sought, is the Military Critical Technologies List. First established by law in 1979, the list is a comprehensive guide to the high-powered U.S. technologies that the DOD fears will be useful to the Soviet military. The DOD is looking for stricter proscription of technologies on the list.

For its part, the semiconductor equipment industry is lobbying to reduce licensing strictures. This industry is at a focal point in the technology-transfer debate because it is a keystone industry—from small chips do large systems grow.

"In our opinion, many of the new regulations are aimed at semiconductor manufacturing technology," says Michael Ciesinski, Washington lobbyist for SEMI, the semiconductor equipment manufacturers' industry association.

Increasing regulation carries with it burdensome and costly paperwork requirements, according to Ciesinski. This will create a class of "blue chip" licenses because only the larger firms will have the money to obtain them.

But the regulations speak loudest to the firms' competitive edge. SEMI worries that a clampdown may drive foreign customers to suppliers outside the U.S. Rather than purchase equipment with a dubious spare-parts pipeline, foreign buyers will seek companies that are unlikely to find their equipment suddenly on a restricted-technologies' list. Still, SEMI looks to passage of an export administration act, perhaps reasoning that known regulations will bedevil an industry less than unknown rules still to come.

Bedrock tech. Although semiconductor fabrication equipment may be the keystone to the world of production electronics, basic scientific research is the cornerstone of all technology. Here, too, industry and academia are both wary of regulation.

In its effort to stem the flow of sensitive technology, the DOD has turned to defense contractors and universities with research contracts as the main enforcement arena. The DOD's policy push culminated in a November 1984 directive prohibiting disclosure of technical data that, it says, might make "a contribution to the military potential of any country."

But though industry leaders don't dispute the need for military security, they charge that the DOD's policies have produced a spillover effect in the engineering community.

According to Richard Gowen, 1984 president of the Institute of Electrical and Electronics Engineers, the chill of the current atmosphere discourages people from participating in technical meetings.

In a recent letter to Secretary of Defense Caspar Weinberger, Gowen wrote, "the Department of Defense has embarked on a course that . . . may threaten the technological supremacy of the U.S."

Referring to the letter, Gowen says, "My real concern is that contractors and military people who have historically played an important role in the development of technology may be discouraged from participating" in technical conferences and meetings.

But Secretary of Defense Weinberger, in a reply to Gowen, assured the

Uncovered. D. Frank Bazzarre, center, founder of Technics Inc., leaves federal court in Alexandria, Va., accompanied by attorney Plato Cacheris (far left). Bazzarre, who pleaded guilty to charges of illegally exporting $6.5 million of restricted semiconductor fabrication and test equipment, faces up to 15 years in prison and fines of up to $5 million.

Eastward bound. The 1985 president of the IEEE, Charles A. Eldon (left), will travel to the USSR next month to explore renewed ties with the Popov Society, the Soviet engineering group.

IEEE that "there will be no interference in the way a professional society organizes or operates unclassified conferences."

Previously, a consortium of universities had bridled at the thought that they might be subject to a rising tide of limitations on research. The presidents of three universities—Donald Kennedy of Stanford University, Marvin Goldberger of the California Institute of Technology, and Paul Gray of the Massachusetts Institute of Technology—told government officials early last year that their schools would refuse unclassified basic research contracts if the DOD were to restrict the publication of findings. The DOD responded with a pledge that it would make no restrictions in basic, or category 6.1, research.

Still, U.S. universities often find themselves in a contradictory position. On the one hand, schools are eager to preserve their status as centers of unfettered inquiry. Many believe the right to publish falls under the same constitutional protection as the right of free speech.

At the same time, many universities conduct exploratory research (category 6.2) for the DOD as well as commercially funded research. They are on guard against disclosure limitations in these areas that might spawn a backlash of tighter rules in the 6.1 category. In addition, increasing debate might point up contractual research ties that the universities would prefer to shield from the glare of publicity.

Extra-territorial. Basic technical research is also seen as one way to renew ties between U.S. and Soviet engineers and scientists. Hoping for scientific detente, the National Academy of Sciences launched a round of globe-hopping this past January. An academy delegation, headed by president Frank Press, visited with members of the Soviet Academy of Sciences. Talks led to a draft protocol, subject to ratification by both societies, that "calls for cooperation in forefront fields of science in which both our country and the Soviet Union are advanced," according to a statement by Press.

In May, IEEE president Charles Eldon and president-elect Bruno Weinschel will go to the Soviet Union to meet with the IEEE counterpart, the Popov Society. They are investigating reopening relations with the Soviet engineering society.

Eldon says that there are sensitive areas: "If someone writes an article about a state-of-the-art radar system, I don't expect that to show up in an IEEE publication." But he thinks that technical exchanges will be beneficial. "There are well-trained people, good engineers, in Russia, too."

Restricting access. Many in industry agree with B.R. Inman, former deputy director of the Central Intelligence Agency, that "you are not going to totally block Soviet access. The most you can hope for is to preclude early access by making [technology] difficult to get."

But technology transfer is no longer a narrow-focus issue, says Inman, now head of the Microelectronics and Computer Technology Corp. research consortium. "Since creation of technology is taking place in Japan and in Western Europe as well as the U.S., it is no longer a question of just U.S. technology being used in an innovative fashion abroad.

"You cannot deal with the problem as a Fortress U.S.A.," he adds, noting that efforts to control transfer of technology to the Soviets must be coordinated multinationally. So far, though, attempts to forge a worldwide approach have been largely unsuccessful. A Coordinating Committee, CoCom for short, made up of most NATO countries plus Japan, has tackled the problem. But instead of protecting against unwanted technology transfer, CoCom has become a protectionist tool, Inman argues. The group has ended up blocking the access of various countries to export markets.

William C. Norris, chairman of Control Data Corp., has looked to cooperative ventures with the Soviet Union and Eastern Europe as one way to thaw trade chills. As one example, he points to the magnetic disk manufacturing plant Control Data has operated in Romania since 1973. This month, according to Norris, the arms-control talks in Geneva could be the first step toward a "reopening of the economic dialogue between the U.S. and the U.S.S.R."

Broad focus. B.R. Inman, head of Microelectronics and Computer Technology Corp., says that technology transfer now encompasses advances made in other countries.

Speaking at Duke University, Norris said, "There is a reluctance—usually unspoken—on the part of some to do business at all because they don't want to see the Soviet economy strengthened." But extensive export controls, while shutting U.S. companies out of the Soviet market, don't appear to have set the Soviets at a material disadvantage, he says.

Meanwhile, the Soviets have lots of technology ripe for commercial exploitation. Hence the U.S. should "assure that in any transaction with the Soviet Union transferring important technology, we will get back an equivalent technology." ☐

Additional reporting was supplied by J. Robert Lineback, in Dallas, and Larry Waller, in Los Angeles.

CLEARLY SEEN LASER LIGHTS NEW USES

Kawasaki, Japan

The impetus for an increase in laser applications may come from a new visible laser—along with the reactor used to fabricate it. NEC Corp.'s new room-temperature laser for continuous-wave use operates at a wavelength of only 671 nm.

The proprietary dual-growth-chamber vapor-phase-epitaxial reactor, which can efficiently produce heterojunction devices, is applicable to a wide range of laser configurations. Both the laser and the chamber were developed at NEC's Opto-Electronics Research Labs and Fundamental Research Labs here.

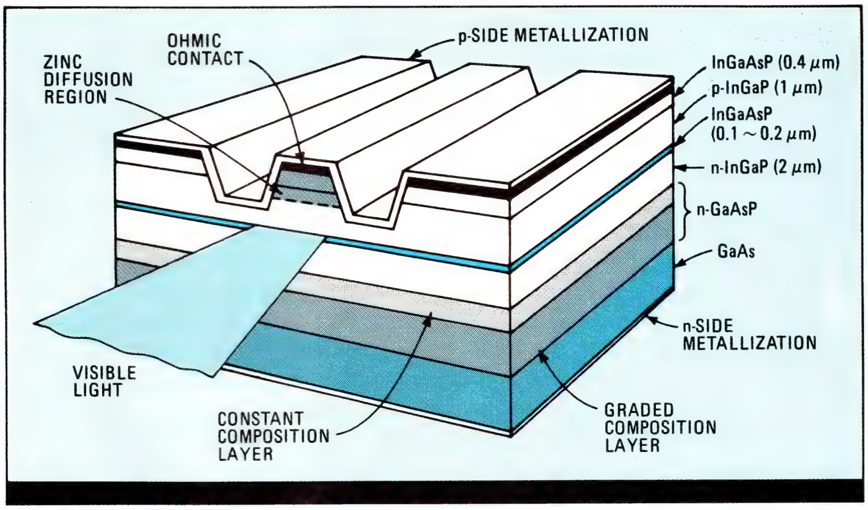
Compared with the 780-nm versions now being produced for high-volume applications such as compact-disk digital audio, the shorter-wavelength lasers have manifold benefits. The laser's visibility—2,000 times greater than the 780-nm models—opens the way for use in optical instruments. For printers, shorter wavelength increases the sensitivity of drums, making for faster writing speeds. A shorter wavelength also makes it possible to pack more information on optical disks.

Perhaps predictably, the proprietary dual-growth-chamber vapor-phase-epitaxial reactor used for fabrication resembles the liquid-phase-epitaxial systems commonly used for laser fabrication. Wafers attached to a crank arm can be moved between growth chambers that supply different hydride gas mixtures for growing clad or active regions within 1 s, making for sharply defined boundaries. Gas flow is constant. In this respect, the reactor resembles the liquid-phase epitaxial setup, in which a boat slider moves the wafer from one melt to another.

Neat reactor. Vapor-phase epitaxy, however, is mechanically neater than liquid-phase epitaxy because there are no sliding surfaces in contact and because it does away with limited size melts that change composition during processing. Conventional vapor-phase-epitaxial reactors with a single growth chamber cannot produce double-heterojunction lasers because composition control is performed by changing gas flow with valves. This cannot be done rapidly enough to achieve sharply defined boundaries. For processing a 2-in. wafer with even greater control, NEC engineers have developed a three-chamber reactor.

The new laser is fabricated on commercially available gallium arsenide phosphide substrates. Actually, the bulk of the substrate is GaAs, on which a region of GaAsP with graduated phosphorus content provides lattice matching to a constant composition layer. The substrate is n-type semiconductor throughout.

The heterojunction consists of four layers: a 2-μm clad layer of n-type indium gallium phosphide, a 0.1- to 0.2-μm active layer of undoped indium gallium arsenide phosphide, a 1-μm clad layer of p-type indium gallium phosphide, and an undoped 0.4-μm indium gallium arsenide phosphide cap layer.



Zinc diffusion. In NEC Corp.'s visible-light laser, zinc is diffused into the cap layer of each device in a 7-μm-wide stripe and then a gold-zinc film that makes ohmic contact to the zinc-diffused region is deposited. Two moats are etched, defining the laser stripe.

Zinc is diffused into the cap layer of each device in a 7-μm-wide stripe, and then a gold-zinc film that makes ohmic contact to the zinc-diffused region is deposited. This is followed by etching two moats that define the laser stripe and deposition of metal contact. Current flows only through the laser stripe region. Cleaved chips 125 μm in length are mounted upside down on a diamond heat sink. Threshold current at room temperature is 56 mA, but NEC hopes to get to 20 mA for practical use.

Other attempts. Fujitsu Ltd. has reported room-temperature cw-laser operation at 727 nm using indium gallium arsenide phosphide on GaAs, and a group at Sharp Corp. has reported cw-laser room-temperature operation at 683 nm using gallium aluminum arsenide. This latter design may not be suited for practical applications at these short wavelengths, however, because increasing amounts of aluminum needed for wavelengths shorter than 700 nm decrease internal quantum efficiency and increase threshold current.

The NEC labs do not plan to stop short at 671 nm. In one to two years, they hope to fabricate practical devices using the 633-nm wavelength of helium-neon lasers—which are big, require large power supplies, and consume watts instead of milliwatts. Practical devices based on helium-neon would provide even greater visibility, since the eye's sensitivity eye at 633 nm is several times greater than at 671 nm. **–Charles L. Cohen**

NO RUSH TO MEET NEW STANDARD

New York

Four major military suppliers of hybrid microcircuits have had their manufacturing lines certified under the new MIL-STD 1772 recently. Two more suppliers expect certification within the next few weeks. But an overwhelming number of manufacturers haven't yet applied for certification of their lines, says the Defense Electronics Supply Center (DESC), the government agency that audits and certifies facilities under this standard.

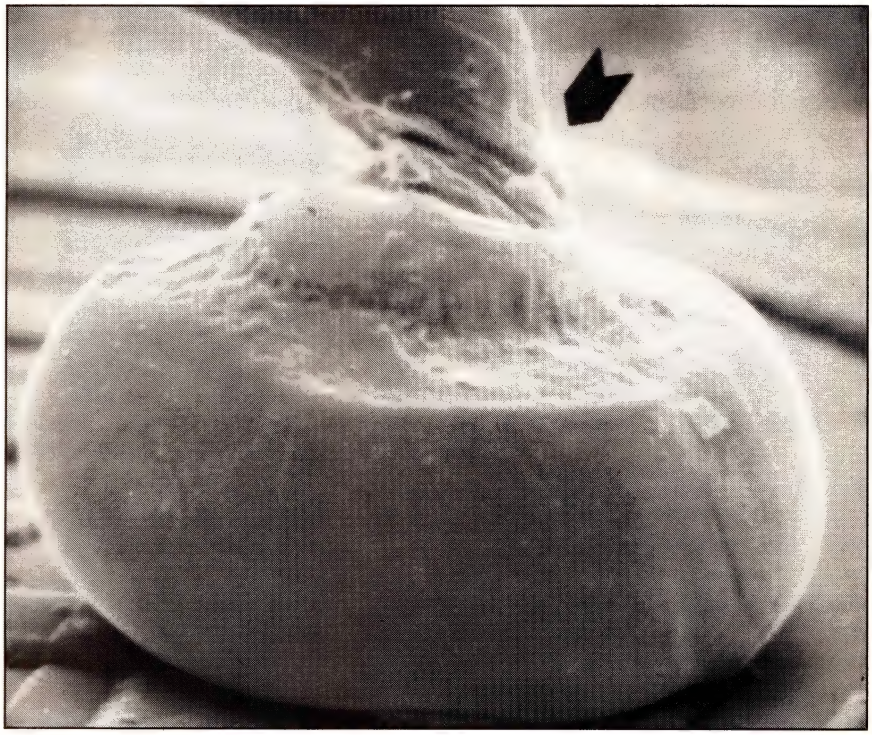
The standard, which came into effect in May 1984, covers production and testing procedures, documentation, and training of personnel at manufacturing sites that produce hybrid circuits for the government.

Honeymoon is over. Critics of the program say that companies are hesitating because the standard has not been enforced. But the honeymoon is not going to last forever. Beginning as soon as 1987, sources say that the Air Force will award contracts only to those firms with certified lines. Adding to the need for action is that the industry expects government demand for hybrid microcircuits to significantly outweigh supply by 1990.

ILC Data Device Corp. was one of the first microcircuit makers to have its line certified. But the Bohemia, N.Y., company's vice president of quality assurance, Dan Epstein, says, "If we had to do it again, I'm not sure we would."

Compliance with the standard, which emphasizes environmental control as well as testing procedures, cost ILC approximately $700,000. And that is for a company that could plan well in advance to build the standard's required features for production and documentation into expansion plans, because Epstein was a member of the industry-government committees that developed the new military standard. But as he now says, "Why do it if the government doesn't enforce it?"

Still, Epstein says he believes in the standardization process. But he maintains that inspectors are discouraging compliance with MIL-STD 1772 by being too picky in their audits. To add to the disincentives, the government is still buying products manufactured on uncertified lines.



Fatal fault. A scanning electron microscope detected this twist in gold wire that caused a stress point at a ball joint, an unacceptable defect under MIL-STD 1772 for hybrid circuits.

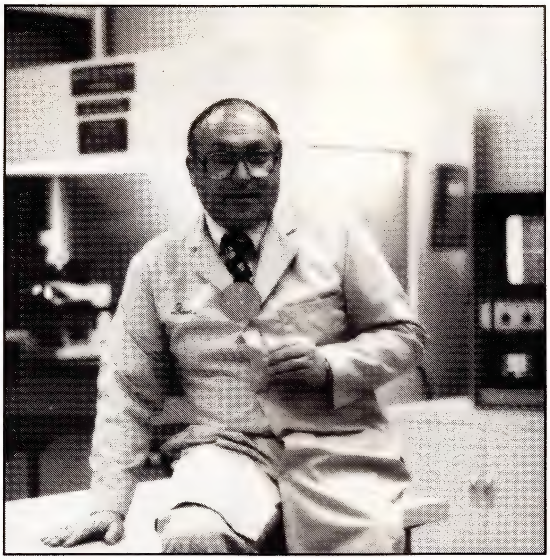
Certification spreads. At DESC, engineer Christopher Shillito reports, "Out of a field of about 500 companies [supplying the military] in this industry, the four hybrid-circuit manufacturers with certified lines to date under 1772's Section A are Teledyne Microelectronics, ILC, Burr Brown, and Elantec. Analog Devices and Interconics are pending certification within the next few weeks. We expect about 14 lines to be certified in 1985 out of the 30 or so we're now looking at.

"We're not in the position to require anyone to get certified, but the major companies in the military business are working toward it. It takes about two years for a standard to work its way into the system. As for ILC DDC's efforts, I think they're making a better product now."

DESC audits often reveal similar problems. These include inadequate atmosphere controls, inadequate incoming-inspection documentation and procedures, test methods not performed to the letter and intent of the standard, inadequate electrostatic-device procedures, inadequate wire-bonding controls, and lack of documented product-assurance plans.

Push comes to shove. Leon Hamiter, vice president of Parts Technology Inc., a consulting firm that conducts preaudit surveys to help firms meet MIL-STD 1772, points out that to demand compliance too soon would push many small manufacturers out of the market because meeting the standard is very expensive, and the government realizes this. Shillito says that one manufacturer claimed it would have to make capital-equipment purchases of $3 million to meet the requirements.

"We're mandated to make sure the manufacturers [that seek certification] meet all the requirements, and we have to make sure the company has the capabilities and controls,"



Lukewarm. ILC's quality-assurance chief, Dan Epstein, says he isn't sure he'd be willing to go through the compliance procedure for 1772 again.

says Jim Blanton, an electronics technician at the defense electronics center. "The problem is that the companies that sought certification didn't think these requirements would be enforced to the letter. They thought we would just look at intent. As for ILC DDC's efforts, well, they have a better product now."

Other companies working toward certification say they foresee no fast increases in profits, but agree that the process of compliance with the standard got them better organized and more streamlined.

Analog Devices Inc.'s Russ Ver Nooys, product marketing manager, says the feeling at his Wilmington, Mass., company is that meeting MIL-STD 1772 will be a requirement for miltary contracts. So the firm is getting ready for 1986 and beyond.

At Burr Brown, in Phoenix, Dan McGraw, general manager of the Military Products Division, says his company wasn't concerned with short-term benefits. Its certification efforts cost in the five-digit range. "In the long term, it will avoid duplication of efforts. We'll be able to offer a standard product that is qualified, and we won't have to resort to individual source-control drawings."

Would Burr Brown go through the process again? McGraw says yes. "We believe it's the right way to do business, and negative comments would be premature. I can say it is going to require constant vigilance on our part because 1772 is still evolving." **–Merja Lehtinen**

WAFER-SCALE INTEGRATION

AMORPHOUS SILICON MAY BE THE KEY

Troy, Mich.

Despite the black cloud generated last year by the highly publicized failure of Trilogy Systems Corp. to develop a wafer-scale approach to very large-scale integration, efforts to perfect a workable wafer-scale technique are continuing at a number of locations. One of the most promising comes from Mosaic Systems Inc., a three-year-old startup here that is pursuing a unique approach based on the use of amorphous silicon to electrically interconnect chips on a wafer.

Like other firms, Mosaic has run into its share of problems. It missed its target date for delivery of first working prototypes last spring [*Electronics,* Sept. 22, 1983, p. 48]. But now—about a year behind schedule—Mosaic has produced a working unit that incorporates 22 chips on a 4-in. wafer. The prototype wafer-level unit has attracted the attention of such firms as Floating Point Systems Inc., which hopes to use the Mosaic technology in its future products.

Mosaic plans to move eventually to a true wafer-scale-integration system for interconnecting the randomly occurring, functional undiced chips on a wafer. But the firm's initial approach involves the downbonding and interconnection of diced, off-the-shelf chips on a specially prepared wafer that Mosaic calls a Whip (for wafer hyper-interconnection package).

Whip it. The Whip concept traces its roots to Burroughs Corp., where Mosaic president Robert R. Johnson headed wafer-scale-integration development efforts until 1981, when he joined Energy Conversion Devices Inc., a pioneering amorphous-materials company located here. Mosaic holds licenses both from Burroughs and from ECD, which is also a Mosaic investor.

Besides the potential for building smaller systems, wafer-scale integration holds promise for significant improvements in system speed and reliability—the result of shorter circuit paths between components and fewer mechanical interconnections.

By providing for the electrical programming of chip interconnections, Mosaic's approach promises what could be the cheapest and easiest way yet to link up chips on a wafer, eliminating the need for a custom mask or wiring scheme employed on other wafer-scale approaches.

The Whip owes its easy programmability to an antifuse technique based on amorphous, or noncrystalline, silicon. Amorphous silicon serves as an insulator sandwiched between layers of 11-μm-wide metal lines; these are vapor-deposited in a matrix that forms a grid pattern corresponding with some 1.7 million programmable vias on the wafer.

To program the Whip, voltages are applied down the appropriate wire lines in the matrix, so that a 20-V threshold is exceeded at the point where a via is to be programmed. Rather than break an existing connection, as occurs with conventional fuses, the voltage causes the insulating amorphous silicon in the via to undergo a phase transition into crystalline silicon. This becomes an electrical conductor between metal layers for hooking up chips.

Glitches that have held up production of a working prototype until now involved the processing of the Whip wafer itself, which requires 11 depositions and eight masking steps

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EF 68000 - 12.5 MHz	X	X	X	Q1	Q1	Q1	Q2	Q2	Q2	Q2
EF 68000 - 16 MHz	Q2	Q2	Q4	Q2	Q4	Q4	Q4			
EF 68008 - 8 MHz	X	X	Q4		X	X				
EF 68008 - 10 MHz	X	X	Q4		X	X				
EF 68008 - 12.5 MHz	X	X	Q4		Q4	Q3				

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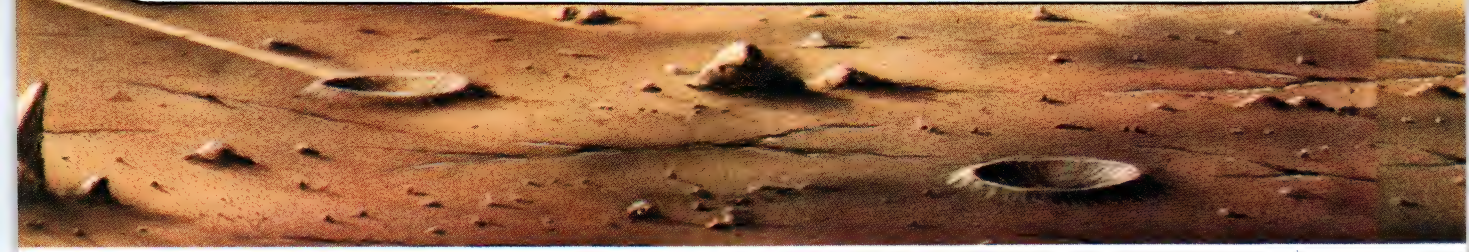

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5400

for fabrication. Initial versions of the Whip contained vias that were undergoing phase transition at less than the threshold voltage, says Johnson. The problem has since been traced to nonuniform thicknesses of metal layers. Additional problems came with achieving adequate step coverage over the 1-μm-thick metal layers, which led to wafer defects.

These difficulties have now been overcome, according to Johnson. Though he won't reveal details of the fixes, he says that changes in the process sequence coupled with other alterations are being incorporated into a new wafer-mask set currently being fabricated.

In fact, Mosaic now expects to increase the thickness of the metal to perhaps 2 to 3 μm, Johnson says. This will improve performance because of the resulting reductions in metal-line resistance and capacitance. Mosaic's president hopes the new approach will increase Whip yields from their current 10% range to about 90%, though a 50% yield would support the business.

The 22-chip prototype incorporates 64-K n-MOS memories and Schottky TTL on one wafer to produce a working pseudorandom-sequence generator that Mosaic refers to as a technology verification vehicle. The chips are downbonded on the wafer using a liquid epoxy adhesive; aluminum-wire bonding is used to attach chip leads to the cell pads.

Protoype ready. Later this spring, Mosaic plans to deliver a 50-chip prototype to Evans & Sutherland Computer Corp., a Mosaic investor in Salt Lake City that also hopes to incorporate the Whip technology in its commercial products.

With demonstration of a functional prototype, Mosaic has now passed a benchmark that releases $2 million in funding on top of the $3 million that the firm has already invested in the Whip effort, Johnson says. An additional $1.5 million will come when Mosaic demonstrates a prototype unit based on an actual product design by a customer, for which the target is year's end.

Despite Mosaic's progress, the firm's potential customers stress that the Whip still needs perfecting. "We've been evaluating [Mosaic's] technology and believe that it could be a rather important component of our product line in the future," says Floating Point president Lloyd D. Turner. But he is quick to add that the firm still considers the Mosaic project to be in the research stage. As far as Whip's use in commercial products, an Evans & Sutherland official notes, "I guess we'd be disappointed if it doesn't happen in three or four years, but it's not going to happen in a year."

For its part, Mosaic plans to add numerically controlled equipment to handle chip downbonding and wire bonding, which is now done manually. When used with the software that handles Whip programming under computer control, this will allow production of about 6,000 wafers per year, Johnson says.

Mosaic plans to offer assembled and tested subassemblies that stack Whip wafers as densely as eight to the vertical inch. It may also license customers to assemble their own. Depending on the density and type of devices used, versions will be offered that rely either on air cooling or on liquid-freon or liquid-nitrogen immersion cooling. Though cooling problems have been a bugaboo contributing to the failure of other wafer-scale schemes, Johnson contends that air cooling could handle dissipation of up to about 100 W per Whip; liquid-immersion techniques would boost that capacity to about 1,000 to 1,200 W.

Johnson says that chip testability on Mosaic's wafer-scale product will likewise present no problem, as long as chips used on the Whip are designed with externally available test nodes. **–Wesley R. Iversen**

OFFICE AUTOMATION

OLIVETTI STAKES CLAIM IN VIDEO TYPEWRITERS

Ivrea, Italy

Caught in a classic pincer movement with personal computers on one flank and electronic typewriters featuring enhanced capabilities on the other, the European market for dedicated word-processing systems in 1985 will be smaller for the first time and continue to decline for at least the foreseeable future, predict executives at the headquarters of Ing. C. Olivetti & C. SpA here.

A 5% drop for the year to a total of some 96,000 word-processing work stations follows a 20% rise in 1984. On the other hand, the nascent market for typewriters with video capability is growing at an annual rate of nearly 50%, a figure that Olivetti expects will translate into an installed base of some 350,000 machines as early as the end of next year. During the same period, the market for standard electronic typewriters will rise less than 15%.

Olivetti asserts that, for well-founded reasons, this market shift is a trend rather than a fad. The company's studies estimate that the addition of video and memory to typewriters raises the productivity of their users by an average of 38%, a figure that grows to a whopping 70% for applications such as repetitive correspondence.

Opportunity. Trying to cash in on this development, the Italian firm will go to market this year with what it claims is Europe's first line of electronic video typewriters, machines that integrate a display with various combinations of random-access and magnetic-disk memory. Current market offerings are limited to video and memory add-on modules for existing typewriters, says Olivetti.

Designated the ETV 240 and ETV 250, the machines include a 12-in. cathode-ray-tube display and, respectively, 13- or 21-K bytes of user memory and optional or integrated 3½-in. floppy-disk drives. The ETV 250 features an additional 64-K-byte buffer memory.

With these and future models, Olivetti expects to take some 40% of the European video-typewriter market, a figure identical to the market share it claims in standard electronic typewriters. **–Robert T. Gallagher**

COSTLY GRAPHICS STIFLES NAPLPS

Though it makes transmission cheaper, the ANSI protocol can't take a firm grip on the industry, and videotex can't take off

☐ *by Clifford Barney*

Palo Alto

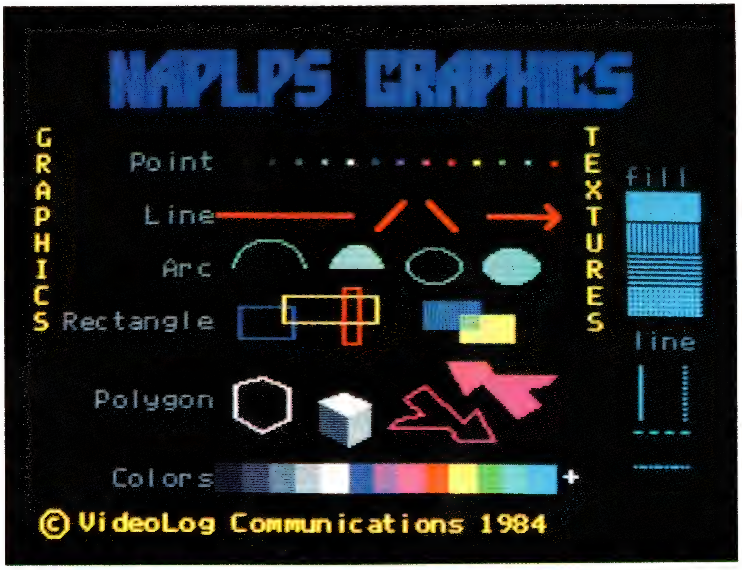
One picture may be worth a thousand words, but at today's prices, the words are still a bargain. Alphanumeric text can be created, displayed, and shipped across telephone networks or internal local-area networks at a fraction of the cost of bit-mapped graphics.

The North American Presentation Level Protocol Syntax (Naplps) saves on communications bandwidth by coding graphics primitives in an ASCII-like structure. Yet even this advance has failed to ignite the long-awaited videotex explosion, which depends on less expensive graphics. Naplps still requires a color display and an expensive picture-generation system—two limitations that have kept graphics services in the boutique class.

"The market is too young," says Bill Chu, founder of Verticom Inc., a Sunnyvale, Calif., firm that began as a maker of $7,000 Naplps graphics terminals. "We can't survive on Naplps as a product." Verticom has diversified into high-performance computer-aided design and manufacturing equipment while waiting for the videotex market to mature.

Nevertheless, the adoption of Naplps 18 months ago as a U.S. and Canadian standard by the American National Standards Institute has brought forth a variety of products and services.

Naplps (pronounced "Naplips" by initiates) has a lot of breadth, if little depth: though put to work in a number of applications, it isn't used extensively in any of them. It is being implemented in software, systems, and semiconductors; it is turning up in shopping malls, offices, and homes; it is even being touted as an eventual replacement for ASCII, because its rich character set can do much more than the alphanumeric standard but is cast in the same general form.



Electronic paintbrush. With the Naplps standard, textures and colors can be transferred to outlined shapes. This is one of an array of visual effects that can manipulate character size, placement, and color.

Naplps implementations include an elaborate frame-creation and display system from AT&T Information Systems, Norpak, and Sony. AT&T Co.'s Series 500 frame-creation system is essentially a minicomputer with several graphics input devices, including a mouse and a graphics tablet. Most significantly, it accepts photographic input, thus solving one of the most severe videotex problems—the automatic generation of screens.

Widely regarded as the Cadillac of videotex systems, the Series 500 sells for $32,900 and operates with an AT&T Sceptre graphics terminal priced at $900. It's used by the Knight-Ridder Viewtron videotex service in south Florida.

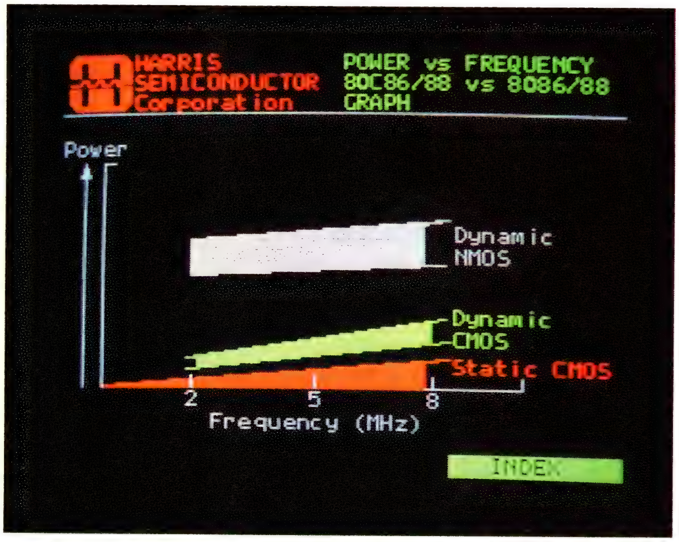
Norpak Corp., Kanata, Ont., Canada, which calls itself the only firm in the world specializing in videotex and teletext equipment, will demonstrate its new IPS 3 (for Information Provider System) this week at the National Association of Broadcasters convention in Las Vegas. Based on an 1123 LSI processor, the new system has two 6809 Naplps engines on an interior Q bus and can capture other systems' frames and modify them.

The Norpak system sells for

$32,500. Sony Corp.'s system, demonstrated at last year's Videotex conference, falls in the same price range.

In addition to home videotex systems now operating in Florida, Chicago, and Orange County, Calif., there is an agricultural weather service called Grassroots in Winnipeg, Man., Canada (with U.S. branches in Delaware and California). Grassroots weather maps are Naplps screens.

Unstable standard. The lack of compatibility, however, between Viewtron and Grassroots—both of which are Naplps systems—is a hint that the Naplps standard is not yet stable. AT&T has its own session-layer protocol (for data buffering and code conversion); terminals that do not emulate its Sceptre will not be able to work with the AT&T system.



Graphic shorthand. Naplps increases the complexity of display capabilities to incorporate text and image on the same screen. A graph of power versus frequency illustrates a short-form study of technologies.

Where consumer videotex has lagged, the first business videotex service appears to have caught on. Videolog Communications, of Norwalk, Conn., has signed on 21 semiconductor manufacturers—including most of the big companies—to enter their product catalogs into a Naplps data base.

Videolog aims at providing parametric searching. This means, for example, that a user can find several companies that make custom microwave circuits and then call up details on pricing and even diagrams of pinouts.

Boeing Co. has adopted Naplps as its internal standard for management-information-system graphics, using Verticom terminals and an IBM 4300 host. Images are generated by a Naplps device driver written by Precision Visuals Inc., which turns Precision Visuals' DI-3000 graphics into Naplps images. This feature relieves Boeing executives from drawing their own screens or writing Naplps code.

Several other major companies, including IBM Corp. and Digital Equipment Corp., are also using Naplps for internal graphics communications. The Buick Motor Division of General Motors Corp., for example, uses a Naplps data base to provide information to its dealers.

Software is available from IBM and from Microstar Software Ltd., of Ottawa, Ont., that turns the IBM Personal Computer into a Naplps terminal. IBM's original software offering, out last fall, costs $250 and does not support the full Naplps service reference model. It offers 16 colors, a resolution of 320 by 200 pixels, and takes 10 s to change a screen. IBM reportedly has a 640-by-350-pixel system in the wings.

Microstar, source of the original Canadian Telidon service software package from which Naplps grew, offers general-purpose communications software for ASCII and videotex. This product's Naplps decoder has also been embedded in a device driver for the IBM PC's disk operating system, designed to work with six popular graphics boards. The new package, which is to be unveiled in June at the Videotex conference in New York, will work with applications programs that generate Naplps sequences.

Semiconductors join in. Most promising of all, several semiconductor houses are in the midst of building second-generation very large-scale-integration controllers that incorporate Naplps. In the past two years, Motorola, Intel, and TI have introduced video controllers supporting the protocol.

Texas Instruments Inc. now has a new version of its chip that can display 256 colors at one time (most chips can display only 16, from a palette of 4,096). The Semiconductor Products Division of Rockwell International Corp. has developed a chip for Norpak that it is now offering as a standard product, to replace some 41 medium-scale-integration and LSI chips. Intel Corp. is promising a controller with windowing, so that Naplps screens can be overlaid with additional text.

The goal of all these chips is to bring down the costs of Naplps displays to under $200. Above that, most videotex firms have found heavy customer resistance.

Naplps is not a coordinate system for creating images, as CAD/CAM is; rather, it is a frame-based system for storing them. It can be used wherever information is accepted by the page, which is what led to its initial application in home videotex.

But the home screen has proven to be the one place that information displayed a page at a time is not useful—at least not yet. In general, the equipment has been too expensive and the services too sparse for the market to thrive.

Personal computer users, however, routinely see information a screen at a time. For personal computers, videotex is the next logical step, says Videolog vice president Gary L. Holland. "The printed page can't keep up the pace. The average product life cycle in the semiconductor industry is two years. By the time you prepare and distribute a brochure, it's out of date."

Industry observers agree that Videolog is more focused than its consumer counterparts. "It's an example of a niche market strategy" that will become more prevalent, contends William Seelinger, chairman of the U.S. Videotex Industry Association and manager of videotex development for IBM.

Cost-effective transmission. Melissa Jones, manager of marketing and sales communications for Signetics Corp., sees on-line transmission of technical data as inevitable because it is cost effective. Signetics now spends

40% of its advertising budget on technical literature, she says.

Despite these encouraging signs, Naplps is by no means pervasive. The most successful on-line data bases offer text only, and the problems of graphics creation, as well as those of decoding, seem likely to keep them that way for some time.

"The most painful part of Naplps is how you create pictures. There is no cheap way to generate Naplps," says Chu, of Verticom.

Creating images. Without one of the expensive frame-creation systems from AT&T, Norpak, or Sony, images must be created from a graphics menu (as in the Apple Macintosh's MacPaint program). Or they must be created by writing Naplps instructions or with a device driver, such as the one that Precision Visuals wrote for Boeing and offers as a product.

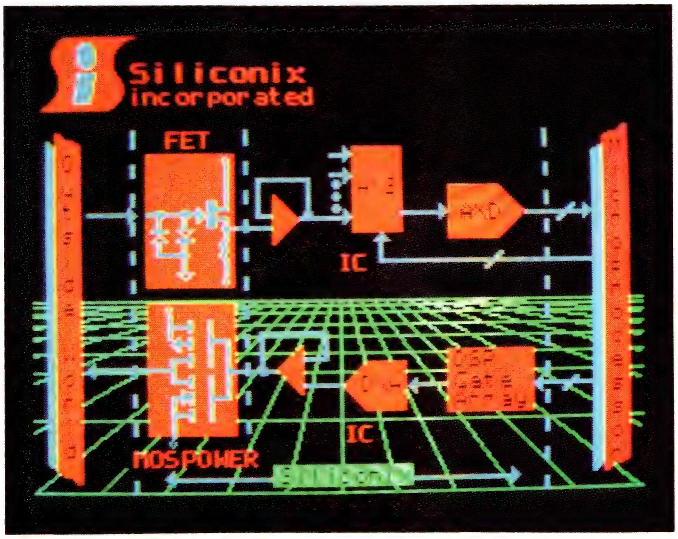
That product, however, is not a howling success. "I get no requests for Naplps support," says Precision Visuals marketing executive Douglas Walton. "It seems to be dead or dormant."

Graphics consultant Richard Puk agrees. "It's either too expensive, or there is no demand for sophisticated graphics. If someone would come up with a chip to generate Naplps, and another to parse it, that would be another story."

"Everyone is waiting for a chip set that updates into the bit map and then displays the results," agrees Steve Dines, manager of microprocessor peripheral product planning for Advanced Micro Devices Inc. "AMD is looking into that area—but there's nothing around the corner. The horsepower of the general-purpose video chip will help Naplps in the next 12 to 18 months. But you won't see a dedicated chip set.

"In common with a lot of other manufacturers, we wonder where the market is," Dines continues. "Will you see a dedicated videotex terminal like AT&T's, or an add-on to the PC, or an add-on to the home TV? If it's the home TV, one of the complexities is that the manufacturer is likely to be Japanese. They have another standard, based on facsimile. If it's an adjunct to the PC, it's unclear what the chip set should look like, because you may want to use some existing hardware—some PCs already have graphics."

Randy Wilhelm, new-product development manager at Intel's Special Components Division in Chandler, Ariz., agrees that chip makers will concentrate on general-purpose chips until Naplps shakes down. Intel is very close to introducing a part that supports not only Naplps but also the European Bildschirmtext and alphamosaic protocols, he says. The chip can be used for home TV sets or IBM PCs.



World of imagination. Concepts may be expanded beyond the obvious. An interpretation of the relationship between the outside world and the microprocessor makes imaginative use of graphics.

"We think that videotex service will migrate into the office," Wilhelm says. "It's also moving into large shopping centers and eventually will go into stores themselves."

Emerging market. At Rockwell International, Hugh Logan, strategic marketing manager for communications, expects that Naplps will find use first in the teletext (one-way distribution of data) market. "We see an emerging market for broadcast distribution of critical, time-changing business data via telephone bypass technology," he says. "The traditional leased-line analog circuit is going up in relative cost, and bypass technology is becoming increasingly attractive. We expect it will begin in 1986 and we think that '87 will be a strong year. By the 1990s, it will be another basic industry."

Logan notes that CBS Inc. is now broadcasting teletext. But he adds that the set-top adapters cost over $500, and it will take much lower prices to ignite the market.

Seeking resolution. TI says that its customers have demanded more resolution than the standard Naplps 200-by-256-pixel brush size and more than the standard 16 colors. The company has therefore balanced its low-end AVDP (for advanced video-display processor) chip, designed for video games and entry-level computers, with a new video systems controller that displays 256 colors and has programmable resolution.

The video systems controller can be the heart of a system that generates screens from a video camera, says Kevin McDonough, group product manager for TI's Programmable Products Division, in Houston. "Last year, we thought the low-end standard reference model would be sufficient as is," he says. "But based on what our customers tell us, we don't see graphics becoming a big requirement until we can support at least 256 colors."

The video systems controller adds resolution and colors by adding memory and has a peak resolution of 1,024 by 1,024 by 32 pixels—the highest available. Louis Jaffe, a consultant who is setting up his own Naplps computer conferencing system on a shoestring, thinks that the protocol can survive the early market buffetings caused by miscalculations in videotex.

"Naplps is holding its own, I think, despite initial false steps," Jaffe says. "Some big companies lost a lot of money betting that video cassettes and video disks would boom overnight. The payoff came much later than they expected, after some early players had dropped out of the game. I think Naplps and home videotex must follow the same scenario. There's no guarantee that Naplps will make it, but it's way too early to call the game." ☐

MINIS SHEDDING HIGH-END IMAGE

As the minicomputer market matures, the emphasis of new products shifts from hot performance to family ties and compatibility ☐ *by Craig D. Rose*

Boston

It seemed to be a continuation of the long-running performance wars around Route 128 when Data General Corp. recently announced enhancements to its high-end superminicomputer soon after the introduction of Digital Equipment Corp.'s high-end VAX 8600 and Prime Computer Corp.'s 9955. Conversations with company representatives at the time of the announcements, however, moved quickly away from high-end performance and drove home a new reality: major players in the industry still strive to offer the hottest high-end computer on the market, but the relative importance of high-end performance has been diluted by new demands from end users.

This shift in emphasis comes at a time when business growth has softened and technology is locked into an evolutionary phase. Perhaps as a consequence, the minicomputer business is also in the midst of a transformation in image.

Industry marketing people have become more eager to talk about families of products and compatibility than mips and whetstones. The new message is: we can do more than deliver high-end performance. Underscoring the message, some public-relations personnel now routinely correct those who call their organizations minicomputer companies; "computer" or "general computer" company have become the preferred labels.

Companies formerly associated with niches appear convinced that niche companies will have a tough time ahead and are seeking to broaden their markets. Harris Corp., for example, which built its base in the real-time market, now seeks the educational and office-automation markets. Both Data General and DEC are pushing hard in office automation, and Perkin-Elmer Corp. reports more sales to banking and securities customers through original-equipment manufacturers.

There are exceptions, of course. Gould Inc. says it has no interest in office automation and will continue to concentrate on real-time applications, where performance is critical. Nor is Wang Laboratories Inc. interested in technical markets. But the trend is clearly moving away from being niche companies and toward being general-purpose computer vendors.

All of this is not to say that pure high-end performance is no longer considered important. According to Gale Aguilar, vice president of corporate business development and strategy at Prime, for one thing, "You are much more likely to hold a top-flight engineering team together if you tell them, 'Hey guys, we're going to have the most powerful machine on the market—this one and the next one and the next one.' "

And of course there are applications that eat up computer power as quickly as it's brought to market. Companies say the demand for power is nearly insatiable. But even for those applications that don't need top-end performance, having it is still important. "People look at mips as an initial criterion but they buy system criteria," says Delmer Hunter, manager of advanced-technology marketing at Data General.

Previously, there was much more buying emphasis on price-perfor-

Glue. High-end design helps keep a top engineering team together, says Gale Aguilar, Prime's vice president of business development and strategy.

mance ratio, Hunter adds. Now, the family of products and solution capability is as strong a factor. "Five years ago, the solution issue was not as strong as it is today," he says.

Customer clout. In developing those solutions, the industry appears to be listening more carefully to customers. Hunter says Data General emphasizes very heavily the "user-perceived functionality of a product family—what can a user get out of a product family, not just the next hottest CPU."

Vendors have also learned that their customers do not perceive a difference between reliability of hardware and the quality of field-service support, says Peter Schay, manager of product marketing for high-performance systems and clusters at DEC. "You need both," he says, adding that in the future, "customer satisfaction will be a much more important interest of computer companies than how hot their iron is."

In addition to quality field service, customers now demand high availability—if not fault tolerance—and most vendors are working to build in as much as they can. One of the primary goals of VAX clusters, for example, was to provide high-availability systems, Schay point out. Another goal was to provide error recovery, which is quite a change from the past. "Minicomputer companies wouldn't waste an extra chip on error recovery in 1975."

Even as vendors are forced to keep pace at the high end of the performance scale and respond to their customers' demands for added features and enhancements, they are finding themselves pressured at the low end of the market by supermicrocomputers, says Peter Lowber, a senior analyst for the Yankee Group in Boston. "Vendors must also be able to plug [personal computers] into their environments," he adds.

In the area of technical development, single-processor superminicomputer performance is stalled at around the 5-million-instructions-per-second performance level. Although this barrier may be surpassed soon, no revolutionary technological breakthrough is expected in the near future.

Aguilar of Prime believes the market will roll for the next three to four years with essentially existing technology. As a consequence, he says, product cycles are shortening. Radical changes tend to lengthen product cycles, in his view, since their high cost must be amortized over longer periods. Nearer to the end of decade, he says, "We could very well see a significant technical change. Maybe it will be gallium arsenide—who knows what it might be—that would be a very expensive change and product cycles will get longer."

Short-term change. Among the likely short-term technological changes is increased emitter-coupled-logic gate density. On the VAX 8600, Schay says, half the cycle time is in gate delay and half in interconnect delay. Increasing the density would substantially reduce the interconnect delay, he continues. "We see significant improvement in cycle time coming from the semiconductor industry, and we certainly don't see this hitting a wall within the next five years."

GaAs, Schay says, will also show up on certain chips within five years, "but as a general-purpose technology, maybe if you're Cray." Rick Maule, director of product marketing for the Computer Systems Division at Harris Corp., says his company will be the pioneer in using GaAs in superminicomputers, making use of work other divisions of the company are doing with the material.

No parallel views. Different vendors appear to weigh the prospects about parallel processing differently. Schay of DEC says, "There are some niches where it appears to have some potential, but the jury is still out on technological aspects. A user has to totally redesign and mentally restructure how to solve a problem. More research is needed."

Hunter at Data General, on the other hand, sees both more tightly coupled processors and much more parallel processing in the nearer term. Still, he says his firm tends to use more "standard technology and devote engineering to higher throughput as opposed to relying on technology as soon as it's available to bail you out of performance problems."

Perkin-Elmer is making the strongest commitment to parallel processing. "We want to be the dominant parallel-processing-computer company of the future," says Michael Solebello, the company's manager of product market for multiprocessor systems. Henry Taylor, the manager of advanced-systems planning for Gould's Computer Systems Division, also says parallel processing is the next logical step.

Whatever technical innovations are incorporated, they will come in a business environment that has substantially cooled. John F. Cunningham, president of Wang Laboratories, attributes the softening to three factors: the depression of foreign revenue caused by the strength of the U.S. dollar, the digestion of the large amount of equipment sold in recent years, and IBM Corp.'s aggressive position in the market-

Sees change. Although past buying has emphasized price-performance ratios, Delmer Hunter, manager of advanced-technology marketing at Data General, sees product family and solution capability as equally important.

place. He expects that the industry is in for a slowdown that will be longer than three months but less than two years.

Stephen Smith, a vice president at Paine Webber Miller Hutchins Inc. who follows the computer industry, believes that IBM is likely to get even more aggressive. Of the competitors, DEC is very strong and remains a technical leader, Smith says. Thus he believes both Data General and Prime will eventually move toward some form of clustering. And he asserts, "The VAX architecture is not as out-of-date as people say. However, in longer terms, there are other architectures that will evolve."

Shock waves. Data General had been doing well in office automation until IBM sent shock waves through that market, and now the company is not doing as well, Smith says. "Data General's problem is lack of presence and lack of credibility in the Fortune 500 market," he says. Lowber of the Yankee Group, says, "Data General is very vulnerable and may have peaked last year. [It] has nothing to lay on the table."

Prime has done well in its traditional technical markets and in expanding into computer-aided design and other new markets, says Smith, who is also impressed with Prime's assistance program to generate third-party software for its machines. "Prime's just begun to come out of the woodwork."

The woes at Wang are those of a niche company whose niche is under siege, says the analyst. "Wang's niche is word processing and office automation," he says. "The problem is that now everyone else offers word processing and office automation as well."

The overriding question for the industry's near-term future is the economy, Smith believes. "The minicomputer business tends to be cyclical," he says. "[So the question is,] is the current softness a sign of a recession or a lagged impact of economic nervousness from last year?"

If the slowdown leads to a recession, he says the hardest-hit company would be Data General because it sells more to original-equipment manufacturers than other vendors do. Digital would also be vulnerable on this account, whereas Prime and Wang sell more to end users. □

News Briefs

Data CAD libraries to use EDIF specification

Right on the heels of the release of Version 1.0 of the recently established Electronic Design Interchange Format, Inacom International has announced the first computer-aided-engineering, -manufacturing, and -design product using the EDIF specification. The product is a structured set of data libraries to support and enhance electronic schematic design, board layout, and circuit simulation when using the most popular CAE and CAD systems. Inacom is a division of International Thompson Information Inc. "When talking to customers, we see that users are not satisfied with the limited libraries currently being supplied with CAE/CAD systems," says Berle E. Larned, vice president of editorial and development. "We are going to fill that gap." Called the Cache CAD Libraries, the Denver firm's latest data offering consists of libraries of graphically represented shapes—electronic chip art—for drawing schematics and laying out printed-circuit boards. About 5,000 chips will be represented in the first edition, to be delivered by June 1. By year end, up to 20,000 chips will be included. These cover digital integrated circuits in TTL, CMOS, and emitter-coupled logic; common memory ICs; microprocessors and support chips; and linear and analog ICs, discrete semiconductors, opto-electronic devices, and passive components from leading manufacturers.

Wells leaves Intersil to become LSI Logic's president

LSI Logic Corp., the mushrooming Milpitas, Calif., maker of application-specific integrated circuits, has plucked another top executive from a rival. George Wells, president of Intersil Inc., has become president of LSI Logic, reporting to founder and board chairman Wilfrid J. Corrigan. In February, LSI Logic lured Keiske Yawata from NEC Corp. to run its Japanese subsidiary. Wells will run the company's domestic operations, while Corrigan oversees the Japanese and European operations (LSI Logic also has a European subsidiary) as well as overall marketing. Founded in 1981, LSI Logic had sales of $84.5 million last year. Corrigan's announced plan is to make the company a billion-dollar operation by 1990 by means of simultaneous market penetration in the U.S., Japan, and Europe. Intersil is a General Electric Co. subsidiary in Cupertino, Calif. GE named James E. Dykes, general manager of its Semiconductor Business Division in Research Triangle Park., N. C., as Intersil president and R. Paul Gupta, Intersil's former operations vice president, as general manager.

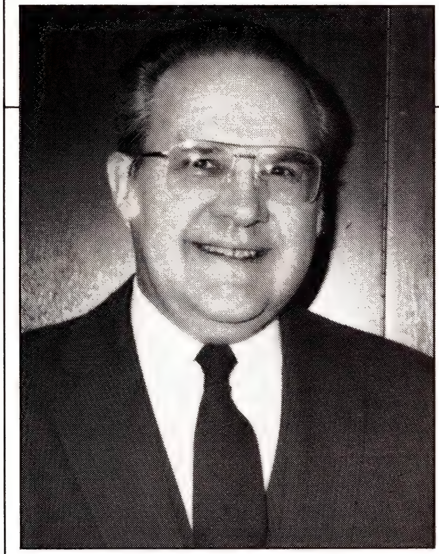
Mideast Arab states to invest $36 billion in telecom in eight years

The Arab nations of the Middle East will invest $36 billion in telecommunications equipment over the next eight years. That is the forecast of Frost & Sullivan Inc., the New York market research outfit. Frost & Sullivan's study predicts an average growth of about 2% a year, from $4.2 billion in 1983 to $5 billion in 1990 (in constant 1982 dollars). The biggest spender, pouring into the market more than $2 billion yearly, will be Saudi Arabia, according to the study, with Algeria chipping in an average of $400 million a year. Only five other countries will exceed $100 million, says Frost & Sullivan. On a per-capita basis, it is clear which nations' economies are based on oil. The figures range from $250 in Saudi Arabia, to $110 to $115 in Bahrain and Qatar, $75 in Libya, and $2 in Sudan.

Brazil closes its CAD/CAM market, turning down two U.S. firms

Brazil has made computer-aided-design and -manufacturing systems part of the market reserved for companies completely controlled by local capital, following a policy that had previously been applied to micro- and minicomputers, modems, terminals, digital ICs, and other digital equipment. The CAD-/CAM law, which dates from Jan. 15, allows 10 companies to purchase technology for the sector from foreign vendors. But the government agency that controls digital technology in Brazil refused projects to transfer technology from two leading U.S. manufacturers, Computervision and Gerber.

EXXON PINS HOPES TO REVIVE ZILOG ON ENGINEER/EXEC SACK



Savior role. Edgar Sack was snatched by Exxon from General Instrument to revitalize its flagging semiconductor affiliate, Zilog.

Campbell, Calif.

When the Exxon Corp. wanted someone to revive its flagging semiconductor affiliate, Zilog Inc., it turned to a researcher who had moved from the laboratory into the executive suite. Edgar Sack was a working engineer for nearly 10 years at Westinghouse Corp.'s research labs and its Molecular Electronics Division before moving in 1969 to General Instrument Corp. as vice president of its Integrated Circuits Division. Sack holds 15 patents and has written some 30 technical papers, including a prophetic 1964 view of wafer-scale integration.

However, it was for his experience as an executive that Exxon plucked him from GI and installed him in Zilog's Campbell, Calif., headquarters. Zilog had lost most of its market share after dominating the 8-bit-microprocessor market with the Z80 in the late 1970s.

Has the answers. After five months in office, Sack can answer the common wisdom about Zilog's failures. It's said, he notes, that Zilog grew on the success of the Z80 but hasn't done much since. "That's a fair statement," he acknowledges. "The company did have some pretty good product plans—but they didn't materialize."

Zilog has also been characterized as a poor relation of its giant affiliate, the Exxon Corp., which was severely burned in its attempt to buy into office automation and now has a lame semiconductor manufacturer on its hands. Here, Sack objects.

"Exxon is our greatest asset," he says. "To be successful in a period like the present one, a firm needs a strong financial backer. Exxon is the biggest company in the world. And it is changing, too. People used to worry because Exxon never pressured us. They invested in high technology and assumed that the technology itself would carry the burden of success. Now it expects more performance from its affiliates. That's healthy for us."

Zilog is also said to have slipped up badly in going from the 8-bit Z80 to the 16-bit Z8000, in that Z80 software could not be migrated upward. And its most embarrassing failure has been the delay in introducing its 32-bit microprocessor, the Z80000.

The first knock, Sack says, is accurate. "We are correcting that with the Z800," he says, referring to a 16-bit coprocessor that is upwardly compatible with the Z80. "The question is, is the customer base still there or has it already migrated to Intel or Motorola? We think that the majority of them are still happy with the Z series." However, they will have to wait until next year for the first samples, Sack concedes.

Two races. The Z80000, whose introduction has been postponed several times, also will not be available for sampling until next year. But Sack contends that the 32-bit race has not yet started. "There are really two generations of 32-bit chips," Sack says. "The first generation consists of the Motorola 68020 and the National Semiconductor Corp. 32032. The second generation will be the Intel 80386 and the Z80000. They are both late because they are such extremely complex chips."

Though mild-mannered and quiet-spoken, Sack will not hesitate to make major shakeups. Already there have been layoffs of several hundred employees (half of them in the company's Philippine assembly plant). Other changes entail basic shifts in Zilog's product strategy. "We used to be a microprocessor maker in a world where companies gave away microprocessors to sell peripheral chips," says Sack. "We are going to accelerate the development of peripherals; we will have five new ones in production in each of the first and second quarters, and 10 to 20 in all this year." –**Clifford Barney**

NAKANO MANAGES DEVELOPMENT OF SOFTWARE-MANUFACTURING AUTOMATION

Tokyo

An early assignment to promote internal computer use at Japan's Ministry of International Trade and Industry gave Masataka Nakano the insight from which he conceived two major government software projects.

Those projects are major accomplishments, considering that he is now only in his third computer-related assignment as he rises through the management ranks in a series of wide-ranging jobs. Nakano spent the three years from mid-1981 on, for example, on loan from MITI to the Japan External Trade Organization in New York, where he was vice president.

Nakano joined the ministry in 1967 upon graduation from prestigious Tokyo University with a degree in international relations. From

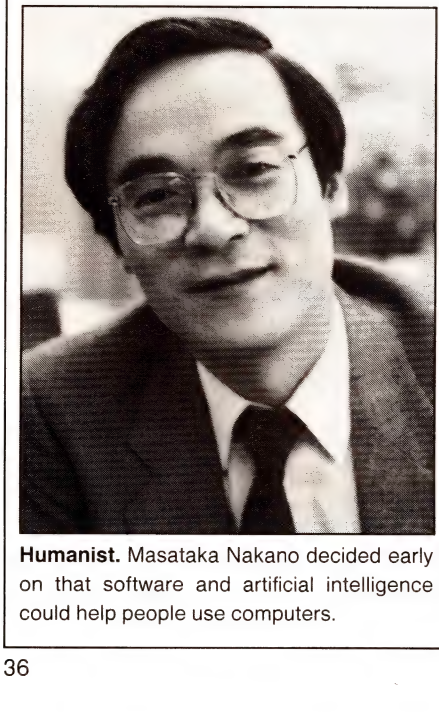
1971 to 1973, he was a section chief in the Data Processing Administration Division, where he discovered "that computers don't work unless they are fed instructions." He realized that "a breakthrough was needed to make them into a tool suitable for use by humans."

Processing policy. His present position as executive director for the Data Processing Promotion Division of the ministry's Machinery and Information Industries Bureau, gives the 41-year-old Nakano a lot of clout. His division formulates the ministry's policy on software, electronic data processing, and new media. Its mandate overlaps that of the Ministry of Posts and Telecommunications on telecommunications, including the value-added networks that are currently a source of contention between the U.S. and Japan.

Nakano has managed to win acceptance of the five-year, $96-million Software Industrialized Generator and Maintenance Aids (Sigma) project for industrial production of software. This project includes development tools to support software automation, transportability of software, and a data-base service for information on software products and related technology. Sigma further includes guidance and computer-aided instruction on the use of the system and a network for remote access. Full operation is scheduled to start in April 1990.

Nakano says the project is needed because "there is no real software industry in Japan, but users have much potential to develop their own." He attributes this to the fact that "the computer is an American product and programming languages came from the U.S. and Europe. Moreover, computer education is superior in the U.S.—Japanese professors are not practical."

Nakano claims credit for planting the seed that has grown into the nation's fifth-generation computer project [*ElectronicsWeek*, Dec. 3, 1984, p. 57]. He was deputy director of the Ministry's Electronics Policy Division, which managed the nation's project on very large-scale integration, from 1977 through 1979. At that time, Nakano "sought breakthroughs in both stored-program computer systems and in sequential processing." **–Charles L. Cohen**



Humanist. Masataka Nakano decided early on that software and artificial intelligence could help people use computers.

SHOWING OFF A GEM, KILDALL HOPES TO ATTRACT COMPUTER MAKERS

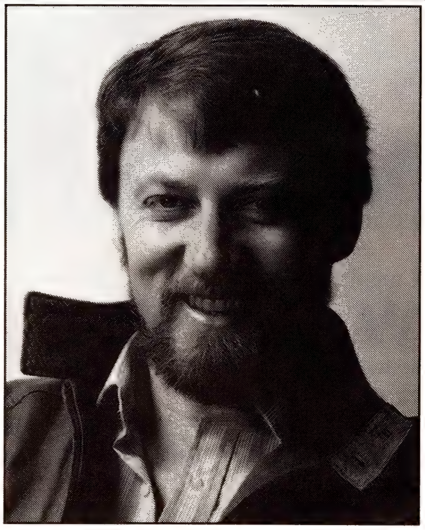
Pacific Grove, Calif.

With a shiny new GEM operating system, Gary Kildall, founder, chairman, and chief executive officer of Digital Research Inc., hopes to breathe new life into the faded firm. The manufacturer of the once-ubiquitous CP/M operating system for early personal computers, DRI no longer holds sway over that volatile market.

It already missed one tremendous opportunity. Early in the personal computer game, DRI refused IBM's Corp.'s request to write the operating system for what turned out to be the IBM Personal Computer, driving Big Blue to Microsoft Corp., producers of MS-DOS. Because of this and poor marketing, DRI has been on shaky ground financially for the past few years, say insiders. Layoffs have been steady companywide, and employees expect another cut in workforce—about 100 people or 20% of the remaining staff.

GEM—for Graphics Environment Manager—is crucial to DRI's long-term success, marking the firm's attempt to establish a new operating-system standard in the personal computer market. The system, which uses pull-down menus and windows to ease operation, has been installed in such potential winners as the new Atari 520ST and the UK's Apricot line from Applied Computer Techniques (Holdings) plc.

Bag of GEMs. As his company rapidly negotiates to adapt GEM to other personal computers, Kildall expects 50 application programs under GEM to be released within the next three months. If the Atari ST with GEM is shipped as promised, consumers will be able to buy what amounts to a 16-bit, lower-resolution color Apple Macintosh for $599.



GEM peddler. Gary Kildall hopes to rejuvenate DRI by selling its GEM operating system to personal computer manufacturers.

Kildall, 42, with a PhD in computer science from the University of Washington, values the trend toward lower prices. "This kind of thing is good for our society in a very basic sense. The concept of value pricing, pricing a product at its perceived, rather than its real [value], has taken over—like pricing a Macintosh at $2,500. I don't think that's the spirit of how this industry started, and I would like to see [that spirit] come back."

Kildall says DRI got lucky with GEM, because VisiOn, VisiCorp's windowing system, flopped in the retail market and has since been sold to Control Data Corp. Microsoft's Windows, announced well over a year ago, won't be released at least until June, and probably later than that. **–Denise Caruso**

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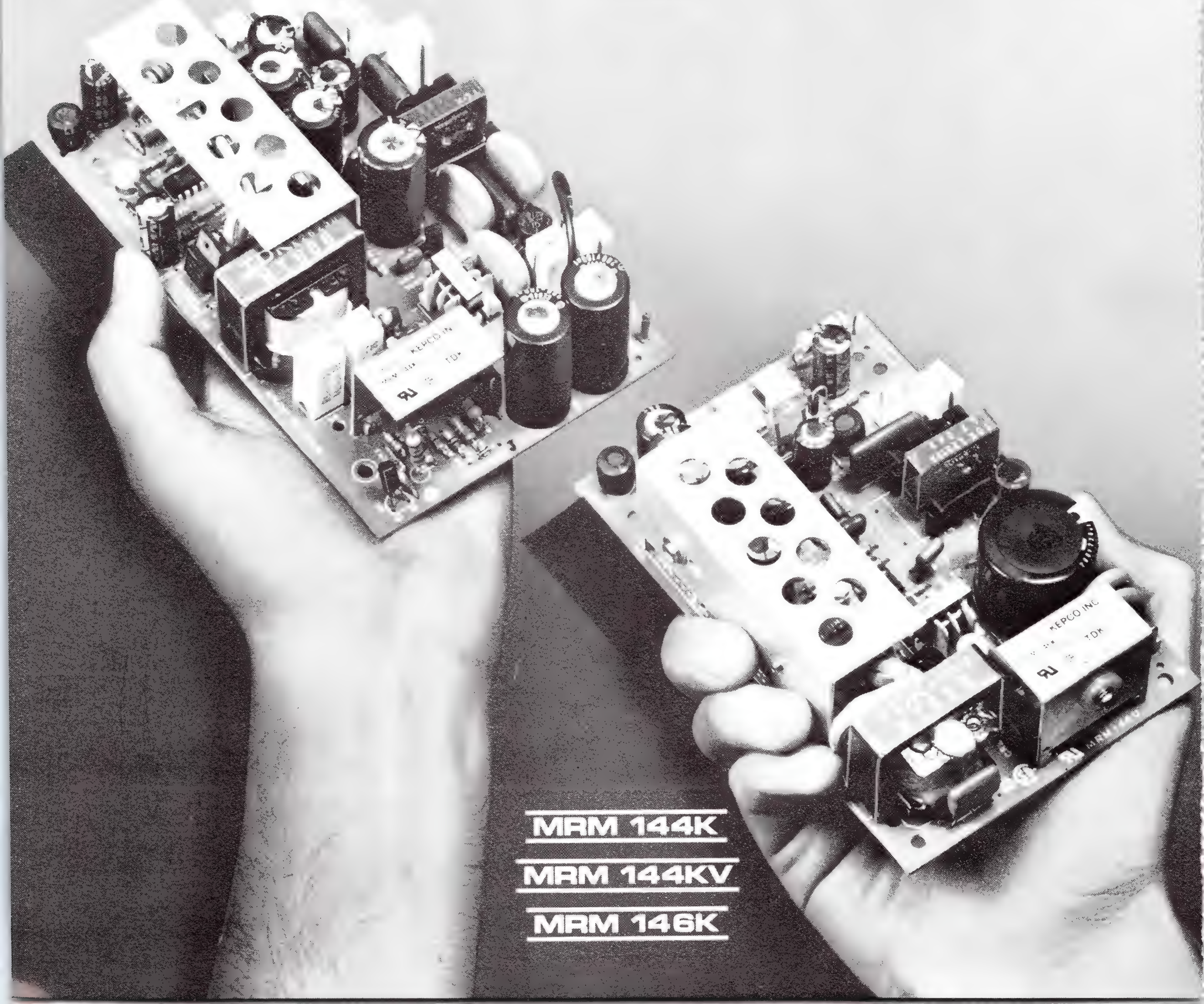

MRM 144K

MRM 144KV

MRM 146K

The Kepco MRM series

The Kepco/TDK series MRM are "frameless" printed-card style flyback converters. They produce multiple outputs selected for the logic, display and communication requirements of CRT terminals and microcomputers. For this use, MRM meet the stringent FCC/VDE conducted noise requirements for consumer products (Class B). The domestic models are recognized by Underwriters Laboratory (UL) and certified by the Canadian Standard Assn. (CSA). The International model (MRM 144KV) is, additionally, certified to VDE 0804/0806 by TÜV Rheinland.

The three models described in this brochure each produce three outputs: +5V, +12V and −12V. The only difference between them are their a-c configuration and safety certification.

The three outputs produce a total of 40 Watts (0 to +50°C). Fig. 1 illustrates the way this power can be distributed between the outputs to suit a variety of applications. NO MODIFICATION IS REQUIRED to do this. Each output is designed to provide any current within its rated range, so long as the total power adds up to no more than 40 Watts. Each output will withstand transient loading up to the tabulated current limit.

A built-in overvoltage protector monitors the +5V output; an overvoltage shuts-down all outputs. It is re-set by turning power off for approximately 20 seconds.

All three outputs share a single return line. Three output connectors are provided, each carrying all three voltages for convenience in fanning out. A quarter-inch ground stud is provided for safety.

Other switching power supplies from Kepco/TDK include single and multiple output models in fully enclosed, shielded housings from 10 to 300 Watts. Low-price open-frame power supplies are available from 65 Watts to 210 Watts. Models are available also for d-c to d-c service. Please feel free to consult us with your requirements.

SPECIFICATION	CONDITION	MRM 144K/MRM 144KV	MRM 146K
a-c source voltage	—	95-135V a-c or 190-270V a-c selectable	95-135V a-c
a-c source current	115V a-c	< 0.9A	< 0.9A
	230V a-c	< 0.5A	—
Half cycle peak current at turn-on	115V a-c	< 30A	< 60A
	230V a-c	< 35A	—
Efficiency	max. load, nominal line	> 65%	
Hold up time	max. load, minimum line	half cycle, minimum	
d-c Output Voltage	Output #1 factory-set to 5.0V @ 2.5A load Adj. range: 4.75-5.25V Outputs #2, #3 fixed in relation to #1		
output #1		+ 5.0V	
output #2		+ 12.0V	
output #3		− 12.0V	
Maximum individual output current	The maximum combined power for all three output is 40W (0-50°C). Output current may be distributed per Fig. 1.		
output #1 (+ 5V)		0.45 to 5.0A	
output #2 (+ 12V)		0.3 to 2.5A	
output #3 (− 12V)		0.0 to 0.5A	
Maximum output power, all outputs combined.	0-50°C	40 W	
	60°C	30 W	
	70°C	20 W	
Source effect (line regulation)	for 115V a-c ± 20V a-c or 230V a-c ± 40V a-c		
output #1 (+ 5V)	load 2.5A	± 2%	
output #2 (+ 12V)	load 2.0A	± 1%	
output #3 (− 12V)	load 0.1A	± 2%	
Load effect (load regulation)	source voltage: nominal		
output #1 (+ 5V)	load 0.45-2.5A	< 5%	
output #2 (+ 12V)	load 0.3 -2.0A	< 5%	
output #3 (− 12V)	load 0.05-0.1A	< 10%	
Temperature effect 0-50°C	source voltage: nominal		
output #1 (+ 5V)	load 3.0A	± 0.5%	
output #2 (+ 12V)	load 1.5A	± 1.0%	
output #3 (− 12V)	load 0.5A	± 1.0%	
Time effect (drift)	measured for 0.5—8 hr @ + 25°C, loaded:		
output #1 (+ 5V)	load 2.5A	< 10 mV	
output #2 (+ 12V)	load 2.0A	< 10 mV	
output #3 (− 12V)	load 0.1A	< 100 mV	
Combined tolerance	limit of voltage for all conditions of rated source, temperature, drift		
output #1 (+ 5V)	load 0.45 to 2.5A	+ 4.75V to 5.25V	
output #2 (+ 12V)	load 0.3 to 2.0A	+ 11.4V to 12.6V	
output #3 (− 12V)	load 0.0 to 0.1A	− 11.0V to − 15.0V	
a–c ripple (source frequency component)	source voltage: nominal temperature 0 to + 50°C		
output #1 (+ 5V)	load 3.0A	< 30 mV p-p	
output #2 (+ 12V)	load 1.5A	< 30 mV p-p	
output #3 (− 12V)	load 0.5A	< 70 mV p-p	
a–c ripple (switching frequency component)			
output #1 (+ 5V)	load 3.0A	< 100 mV p-p	
output #2 (+ 12V)	load 1.5A	< 100 mV p-p	
output #3 (− 12V)	load 0.5A	< 300 mV p-p	
Spike noise	source voltage: nominal temperature: 0-50°C		
output #1 (+ 5V)	load 3.0A	100 mV	
output #2 (+ 12V)	load 1.5A	100 mV	
output #3 (− 12V)	load 0.5A	300 mV	
Overvoltage	+ 5V (only)	5.8-6.8V	
Operating temperature	vertically mounted on 12 mm (½") spacers	0 to + 50°C derated operation to + 70°C see Maximum Power	
Storage temperature	non operating	− 20°C to + 85°C	
Humidity	non condensing	up to 95% RH	
Vibration (3 axes)	5–10 Hz	10 mm	
	10–55 Hz	2 g	
Shock (3 axes)	11 ms ± 5 ms.	20 g	

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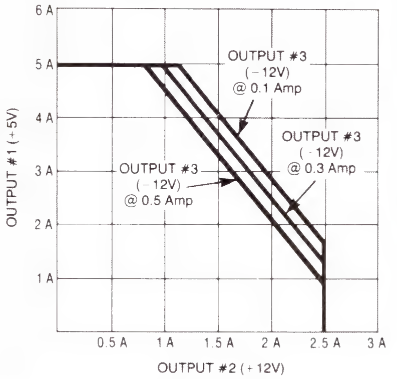
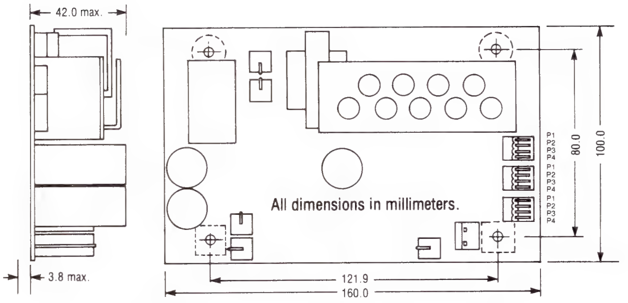
FIGURE 1

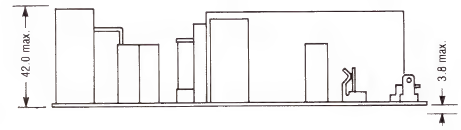


In the chart above, the vertical scale represents the +5V output (#1) and the horizontal scale the +12V output (#2). The three diagonal lines represent three possible loads for the −12V output (#3): 0.5Amp, 0.3Amp and 0.1Amp.

To find the available current from output #2 with any desired load on output #1 and a selected load on #3, locate the desired load on the vertical scale, and move across to the appropriate diagonal. For example, when #1 is loaded to 3Amp and #3 to 0.5Amp, the available current from output #2 will be 1.58Amp, if #3 is loaded to 0.1Amp, the available current increases to 1.98Amp. Other typical combinations: +5V at 2A, +12V at 2A, −12V at 0.5A; +5V at 2.5A, +12V at 2.2A, −12V at .01A; +5V at 3A, +12V at 1.5A, −12V at 0.5A.

To determine whether any three desired loads are feasible, locate the loads for outputs #1 and #2. If their junction is below the appropriate diagonal for output #3, the combination is feasible. For example, with a 3Amp load on #1 and a 1.7Amp load on #2, a 0.1Amp load is possible on #3, but not a 0.5Amp load.

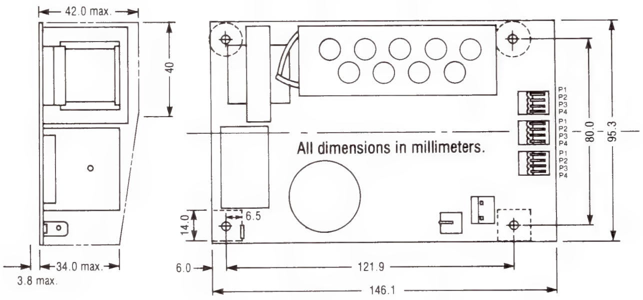


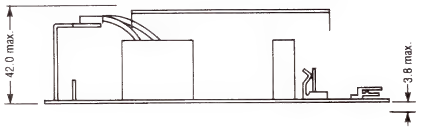


MRM 144K
MRM 144KV

ENGLISH	— Size: 6.3″ x 3.9″ x 1.7″	Weight: 1 lb.
METRIC	— Size: 160 x 100 x 42 mm	Weight: 0.45 Kg.

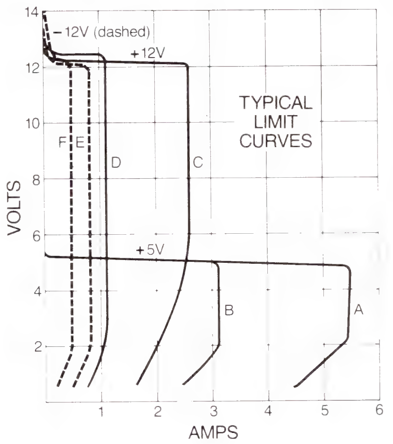
OUTPUT CONNECTORS Molex 5046-04A mate with 5251-04/5659 or 22-01-2047/08-50-0114
INPUT CONNECTOR Molex 5277-02A mate with 5239-03/5167 or 09-50-3031/08-50-0106
GROUND STUD AMP 170267-1 mate with Faston 250





MRM 146K

ENGLISH	— Size: 5.7″ x 3.8″ x 1.7″	Weight: 0.8 lb.
METRIC	— Size: 146 x 96 x 42 mm	Weight: 0.35 Kg.



Interaction effect

Change in voltage from any two outputs as a result of a specified load change on the third.

OUTPUT	LOAD	+5V	+12V	−12V
+ 5V	1.5 —3.0A	—	< 200 mV	< 500 mV
+12V	0.75—1.5A	< 50 mV	—	< 300 mV
−12V	0.25—0.5A	< 10 mV	< 30 mV	—

Current limit threshold current as a function of loading

+ 5V	(A) 5.5A	(B) 3.25A	load 2.5A	load 5A	load 2.5A	load 3A
+12V	load 1.5A	load 2A	(C) 2.5A	(D) 1.0A	load 2.0A	load 2A
−12V	load 0.1A	load 0.5A	load 0.1A	load 0.5A	(E) 0.75A	(F) 0.5A

Current limit characteristics for each output as a function of the loading of the other outputs.

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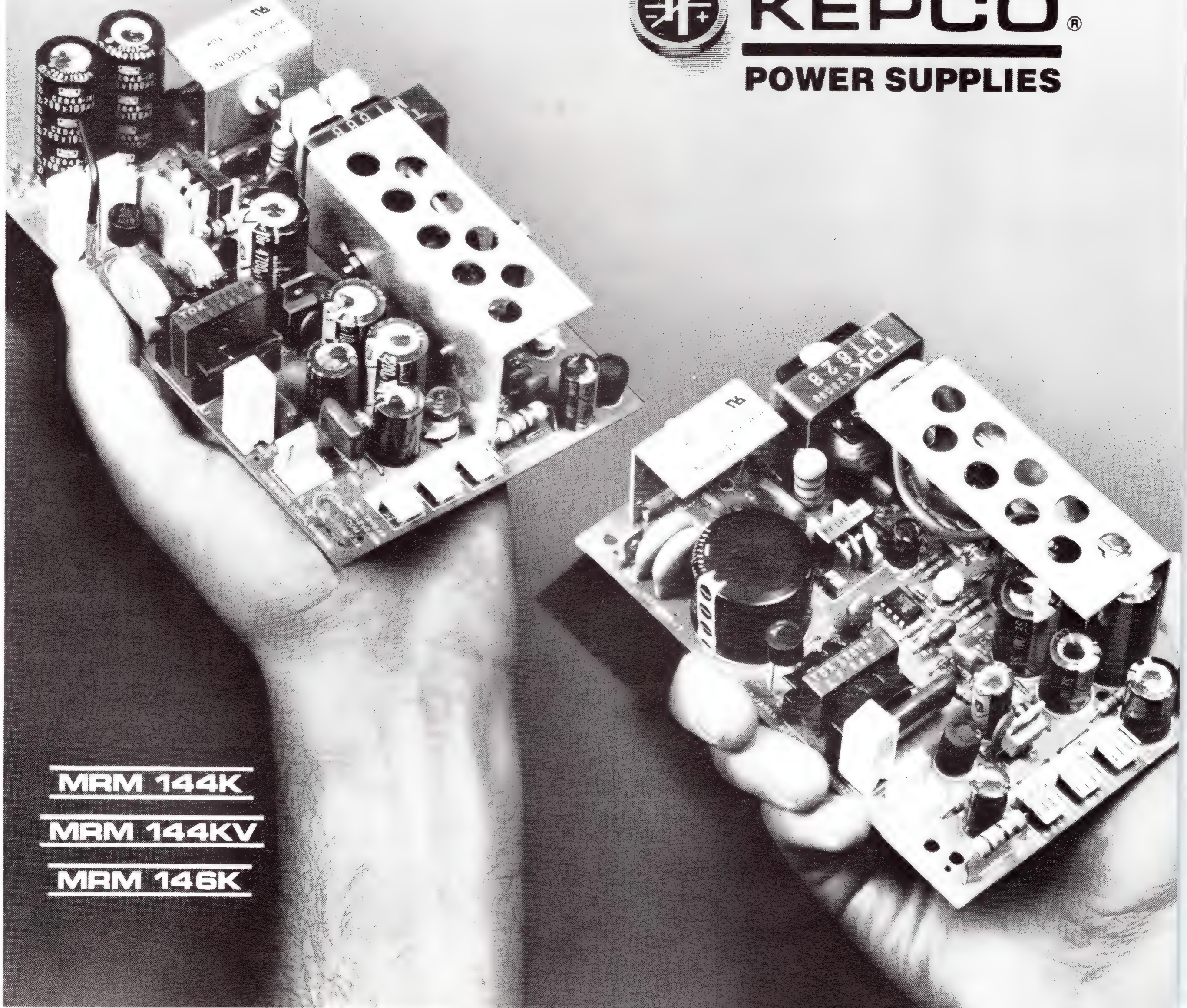


MRM 144K
MRM 144KV
MRM 146K

CONCORD DATA SYSTEMS RIDES HIGH ON GM CONNECTION

Waltham, Mass.

Two years ago, Concord Data Systems Inc. was a small but growing modem manufacturer with big hopes for its token-bus local-area network. But management needed to know where to focus its networking effort. So "we decided to jump on whatever came out of the chute first," says company president Ken Miller.

What jumped out first was a Brahma-bull of an opportunity—General Motors Corp. The automaker was looking for a factory networking standard and asked Concord Data Systems to help with a factory-of-the-future demonstration for the 1984 National Computer Conference. The automotive giant wanted to demonstrate its Manufacturing Automation Protocol, known as MAP.

Executives at Concord Data wasted no time in taking advantage of this good fortune. The company signed on and provided its broadband Token/Net token-bus network to link equipment from a half dozen major companies for a successful MAP demonstration. The market for these protocols continues to build, and the MAP demonstration put Concord Data on the LAN map.

Good position. The privately held company, which employs a staff of 200, claims it had sales of $15 million last year. The firm is now in the enviable position of being the only vendor with a LAN product conforming to the IEEE-802.4 standard for the factory floor. Industry analysts anticipate the MAP market to be $30 million to $40 million this year and to grow rapidly thereafter.

Market researcher Dataquest Inc. forecasts that the total market for LANs will reach $953 million this year, nearly double last year's $489 million, and will top $2.4 billion by 1989. The market for broadband-based LAN systems, such as the one Concord Data offers, will top $37.9 million this year and hit $137.1 million by 1989, according to market researcher International Data Corp.

Company executives predict a doubling in size over the next year. Company officials and industry observers fully expect that Concord Data will soon have competition in the LAN market, but that's O.K. with them.

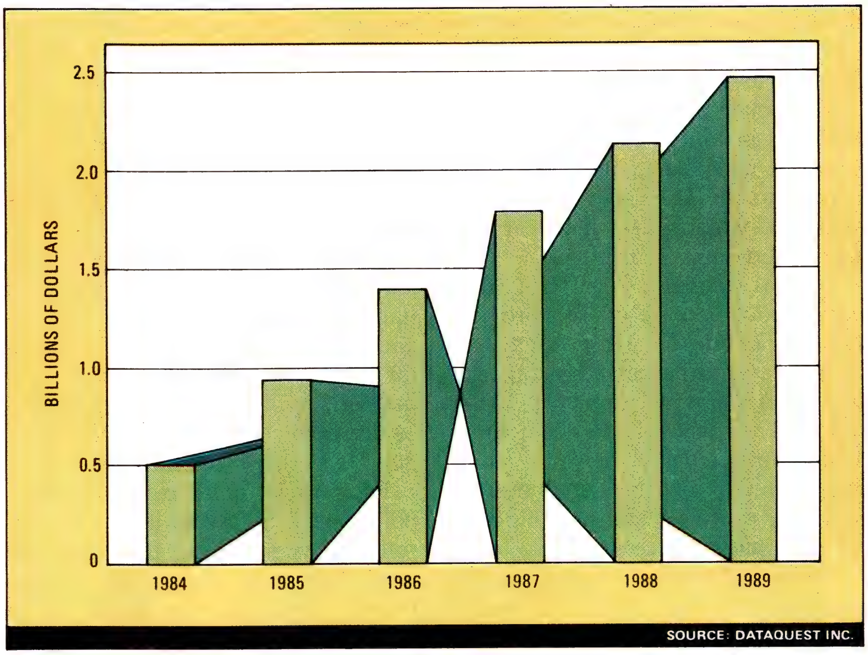
Standards necessary. The only way a little company can succeed is to develop products that meet standards, says Ross Seider, vice president of engineering for LAN products. And though standards bring other vendors into the market, Seider points out, standards also reassure customers who don't want to be dependent on a single small vendor. As the first company in the market, Concord Data is counting on its leadership position to give it an insurmountable lead.

Concord Data was founded in 1980 by Miller and a group of partners who believed that LAN standards were being developed from a limited perspective. They kicked in a modest amount of their own money and raised several rounds of venture capital. LAN standards were set then by computer people beating the drum loudly for Ethernet, the standard first proposed by Xerox, Digital Equipment, and Intel.

Different perspectives. Miller's perspective came from working for eight years at Codex Corp., where he directed modem research. He left in 1980 to work as a consultant and became involved in the IEEE-802 standards committee.

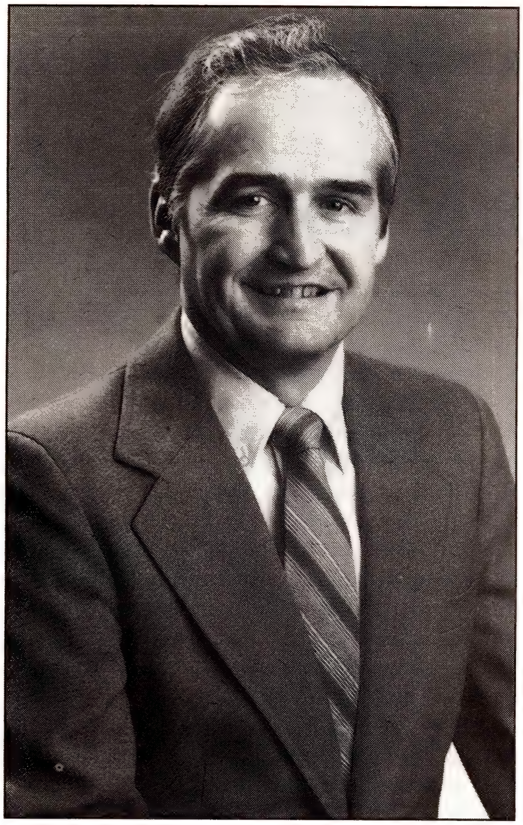
At the time, the word "networking" was most often linked with office applications. The few who were interested in other applications saw problems in the Ethernet standard.

"We looked at it from the perspective of data communications," says Seider, who had also worked at Codex. "If you open a facility, applications come up that you never dreamed of... [A system] has to be able to support not a hundred stations but a thousand or higher and



SOURCE: DATAQUEST INC.

Tiger by the tail. The market for local-area networks is expected to reach $953 million this year from last year's $489 million, and top $2.4 billion by 1989, estimates Dataquest Inc.



Big ride. "I feel as if I'm on this roller coaster going 100 miles an hour," says Concord Data Systems president Ken Miller, whose firm's local-area network is geared to factory applications.

performance has to be predictable."

Concord's challenge in development was to take polling techniques and extend them to broadband cable. It then had to get the token bus accepted as a standard. Because development takes time, the firm's founders decided to simultaneously develop dial-up modem products to generate a quick revenue stream.

In 1982, the company introduced two 2,400-b/s full-duplex dial-up modems aimed at industrial customers and registered sales of $1.4 million. Most of its early sales were overseas.

The token-bus networks were introduced in March 1983. Meanwhile, Concord contributed technical information to the IEEE-802.4 token-bus standard, which later that year was accepted as a standard.

Up to standard. The GM deal came about because of Concord Data's work on the IEEE standards committee and because the company had a LAN product available, Miller notes. The bulk of the company's LAN efforts quickly went into working with GM on the MAP demonstration—a project that paid big dividends when it succeeded.

"With GM getting them in the game, [Concord Data Systems] doesn't have to spend as much time getting its name out" in the minds of users, points out Adam Zais, senior research analyst for International Data. "GM will provide all the marketing they need."

In the meantime, Concord Data Systems has cemented some major relationships in the wake of the MAP success. In January, it signed an original-equipment-manufacturer agreement with Texas Instruments Inc. and more recently completed an OEM deal with Sweden's postal telephone and telegraph agency. These deals are in addition to previously negotiated arrangements with N.V. Philips in the Netherlands and Allen-Bradley Co. in the U.S.

Concord Data, which has a field office in Phoenix, Ariz., is also working with Gould AMI on the development of very large-scale-integration token-bus-controller chips. The company has also begun to ship a general-purpose LAN.

Leading the way. Other competitors are expected to introduce LAN controller chips within a year, which will make access to the market much easier. Analysts expect that end-user demand will take off dramatically as GM's Steering Gear Division Factory of the Future project in Saginaw, Mich.—the most ambitious application of MAP—comes on line. That project is scheduled to begin later this summer.

If Concord Data Systems is to maintain its lead in the market, it must move quickly beyond basics and develop the bells and whistles for the LAN standard—something it has already begun to do, maintains Seider. The company must also bring down the cost of connection.

For now, as chief executive Miller points out, "I feel as if I'm on this roller coaster going 100 miles an hour. Got to be careful, stay in control, can't get off—but I don't want to get off." –**Craig D. Rose**

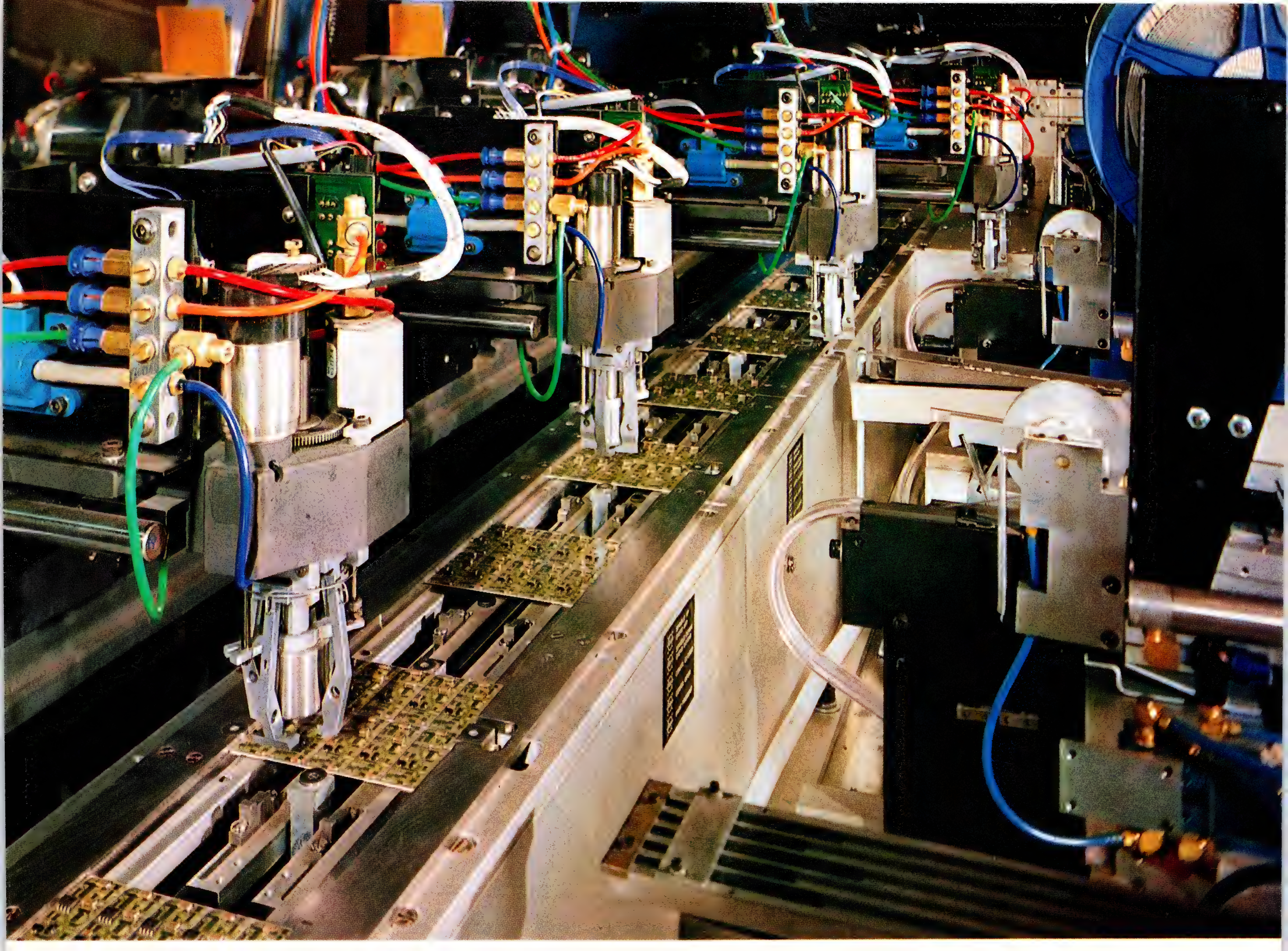
BOTTOM LINES

Capital spending in 1985 to rise. U.S. businesses plan to increase capital spending this year by 10.9%, to $386.5 billion from 1984's $348.41 billion, according to a survey by the McGraw-Hill economic department. At the same time, firms plan no increases in capital spending in 1986.

"However, if the economy continues to grow this year, 1986 capital budgets will grow too," the report points out. Companies in the electrical machinery category plan a 2.3% drop in spending this year, to $13.28 billion from 1984's $13.59 billion. These firms expect to increase spending next year by 4.1%, to $13.82 billion. Aerospace companies plan a 27.5% jump in 1985 spending, to $7.31 billion versus $5.73 billion in 1984; but spending next year will slip 6.6%, to $6.82 billion. Spending by instrument firms will soar 34.7% this year, to $4.42 billion from 1984's $3.28 billion. Next year, spending should be up another 5.6%, to $4.66 billion.

Home computers aren't dead. Despite IBM Corp.'s decision to stop making its PCjr, the market for home computers is not dead, says William Ablondi, vice president of market research firm Future Computing Inc. He estimates that there were 12.2 million personal computers in U.S. homes by the end of 1984. Home computers and office personal computers sold to the home totaled $2.5 billion in factory value last year, compared with $1.7 billion in 1983. "It's very likely that IBM will have a new product on the market by the third quarter of 1985. We'd expect it to have a price tag of approximately $1,000. The Junior turned out to be the wrong product for today's marketplace. Competitive conditions made it impossible for IBM to maintain margins."

Startup computer firm funded. Parallel Computers, a Santa Cruz, Calif., startup that makes fault-tolerant computers, raised $5.8 million in a third round of financing. The firm has now raised a total of $15.5 million. Parallel also entered into an agreement under which Japan's Sumitomo Corp. will market the Parallel 300 computer in that country.



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Surface mount technology is in its infancy, and SMC standardization is in the development stage. Therefore, it is important to select "flexible" placement systems that can handle a variety of components and feeder types. It also is essential for these systems to detect any missing parts during the placement process, and to replace them during an automatic repair cycle. This capability is designed into Universal's SMC assembly systems. The alternate can be finished circuits with missing components that are difficult to detect and replace.

SMC standardization will result in the increased use of surface mounted components. However, use of insertion mounted components also will grow. Except for some extremely high volume consumer electronics applications, industry experts project that use of DIPs and SIPs will grow substantially through this decade, and use of insertion mounted discrete components will not taper off during the next decade. Therefore, new PC board assembly facilities need to be planned with the flexibility to handle changing mixes of both surface mounted and insertion mounted components. Only Universal can provide a full range of compatible assembly systems for both types of components.

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Circle 43 on reader service card

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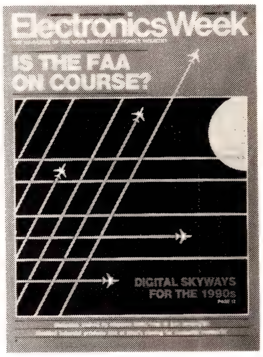

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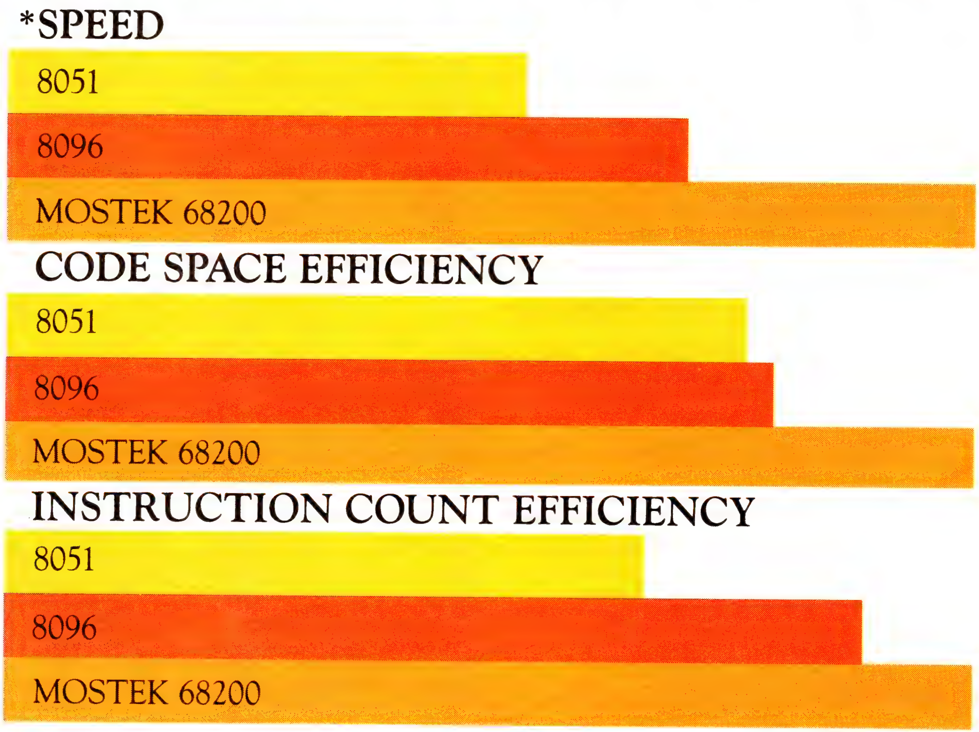

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SPECIAL REPORTS

COMPONENTS FOR SMA ARRIVE

Though the number is minuscule now, by 1990 as much as 70% of all electronic components will be surface mounted ☐ *by Jerry Lyman*

The practice of surface mounting components on printed-circuit boards is beginning to have an impact on the entire components industry. Discrete-semiconductor and integrated circuit manufacturers, along with passive-chip makers, have been supplying surface-mountable components for some time. Now the rest of the components industry is belatedly jumping on the bandwagon by starting to supply new types of surface-mountable components such as connectors, crystals, switches, and relays.

Only 5% to 6% of all electronic components now used in the U.S. (about 250,000 types) are surface mounted. This is minuscule compared with the figure of 47% for Japan, the acknowledged world leader in surface-mounting technology. Nevertheless, some market researchers predict that by 1990, 70% of all components manufactured in the U.S. will be surface mounted. From 1984 to 1985, the total number of surface-mountable components available increased by 27% (Table 1).

Today, with digital technology the dominant force, the most heavily used components are ICs and semiconductors. The mechanical, thermal, and electrical characteristics of surface-mounted packages for these active components have become vital information for the electronics engineer engaged in designing, manufacturing, or testing surface-mounted boards.

The major packages currently in use for surface-mounted assembly work are three small-outline transistors—the SOT-23, SOT-89, and SOT-143; the plastic leaded chip carrier; and the plastic quad flat pack.

Small-outline packages for discrete semiconductors date back to the early 1970s. These are used to house transistors, FETs, and diodes in a plastic package that measures 114 by 51 by 43 mils and dissipates 200 mW in free air (Fig. 1).

The SOT-143 package is a four-leaded version of the SOT-23 with the same dimensions and thermal character-

TABLE 1: SURFACE-MOUNTING-COMPONENT AVAILABILITY IN U.S.

Type of component	1984	1985 change	Total to date	% change (1984–1985)
ICs				
Bipolar memory	1,194	203	1,397	+17%
MOS memory	166	103	269	62
MOS linear	47	58	105	123
MOS digital	2,078	582	2,660	28
Bipolar linear	771	174	945	23
Bipolar digital	4,826	282	5,108	6
Gate arrays	793	318	1,111	40
Microprocessor/support	428	56	484	13
Miscellaneous components	164	8	172	5
Total	10,467	1,784	12,261	+17%
Discretes devices				
FETs	97	28	125	28
npn transistors	808	156	964	19
pnp transistors	509	111	620	22
Unijunction transistors	0	2	2	200
Diodes, standard	181	191	372	105
Diodes, varactor	28	6	34	21
Diodes, zener	383	410	793	107
Total	2,006	904	2,910	+45%
Passive components				
Capacitor families	4,630	1,217	5,847	26
Inductor families	157	388	545	247
Resistor families	324	456	780	141
Thermistor families	88	—	88	0
Total	5,199	2,061	7,260	+40%
Total components	**17,669**	**4,749**	**22,421**	**+27%**

SOURCE: DON BROWN ASSOCIATES INC.

istics. The SOT-89, a slightly larger package than the SOT-23, dissipates up to 1 W with the proper heat sink.

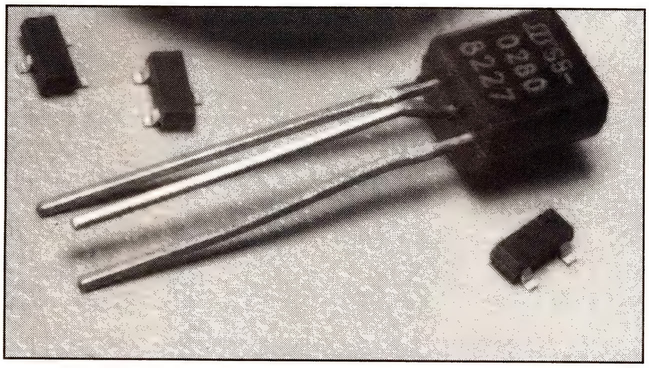
Diodes and zener diodes may be housed in Melf (metal-electrode face bonding) and Mini-Melf small cylindrical leadless packages that can dissipate 0.5 and 1 W respectively. At this time, the designer has about 2,900 discrete components in surface-mountable packages to consider for his designs (see "Directories for surface-mountable components").

Discretes exist, but ICs dominate

Motorola Inc. should soon have a D-pack surface-mountable package that dissipates 2 to 20 W, depending on its heat sink. Meanwhile, Siliconix Inc., Santa Clara, Calif., has announced plans to bring out power MOS FETs in a surface-mountable package.

Discrete active components have their place, but ICs are the dominant semiconductors today. In the U.S., these are being surface mounted in any of three packages—primarily the small-outline IC, or SOIC, the plastic leaded chip carrier, and to a lesser extent, the plastic quad flat pack.

In a paper presented at Nepcon West, Glenda Derman, an analyst with Gnostic Concepts Inc., noted that in 1984, the plastic leaded chip carrier accounted for 9% of the U.S. consumption of surface-mounted packages, and the SOIC accounted for 39% of the same category. By 1988, SOIC consumption in the U.S. should rise to 46%, while the plastic leaded chip carrier should reach 25%. In Japan, the most frequently used packages are the SOIC and quad flat pack.



1. Small-outline transistor. The tiny SOT-23 is shown alongside a TO-92 package. Siliconix Inc. has recently put a family of small-signal FETs in a gull-winged plastic package. Discrete diodes, FETs, and bipolar transistors come in a surface-mountable package.

The SOIC (Fig. 2) is in effect a miniaturized dual in-line package with leads on 50-mil centers rather than the 100-mil centers of the larger package. Its size advantages over the DIP extend to body size, pc-board area, body thickness, and weight (Table 2).

Today, most digital logic families and linear circuits of all types are available in this package, which can have up to 28 leads. As die sizes increased, however, new variations on the SOIC arose. Signetics Corp., Sunnyvale, Calif., for example, has a small-outline package with a 150-mil width and a small-outline large package for higher lead counts and larger dies with a 300-mil width. Both packages have the same lead spacing.

NEC America Inc., Melville, N.Y., has come out with another variation of the SOIC, which it calls the Mini-Flat package. In this variation, the SOIC standard width has been increased by 10% in order to accommodate larger die and to allow for a better package seal against humidity.

The original SOIC had gull-wing-type leads (Fig. 3a). At least in the U.S., there is a move afoot, particularly by Texas Instruments Inc., to use a J-shaped lead (Fig. 3b). Gull-wing leads are easy to inspect, but they take up more real estate than the J-lead. In addition, the J-lead can be socketed or soldered; it cleans easily; and it can be handled more easily by the current generation of pick-and-place machines.

Beyond 28 leads, however, the SOIC is not really cost-effective. At this point, the plastic leaded chip carrier, a square package with J-shaped leads on 50-mil centers, takes over. This chip carrier, which was introduced by TI, has now been accepted by all the major IC producers in the U.S.; Advanced Micro Devices Inc.'s Microprocessor Division, Austin, Texas, is one of the latest to join the crowd, with its 68- and 44-leaded packages.

In Japan, where the quad flat pack rules, NEC Corp.

Directories for surface-mountable components

As surface-mounting assembly continues to take hold in the U.S., more active- and passive-component manufacturers are supplying surface-mountable products. Unlike conventional components, whose sources and product categories are common knowledge to many electronics engineers, the new types of surface-mounted devices, manufacturers, package sizes, and values are almost unknown to most of the engineering population.

Two firms, Don Brown Associates, of Fort Washington, Pa., and AWI, of Sunnyvale, Calif., have created directories of SMDs to assist the puzzled engineer.

The 823-page paperbound directory from Don Brown lists resistors, resistor networks, thermistors, capacitors, inductors, and all types of semiconductors and integrated circuits by company and part number. Other sections list connectors and miscellaneous components (such as relays, switches, and varistors) along with an equipment section and contract services for surface-mounting assembly. This book, which lists more than 21,000 component parts, costs about $500 and includes a free midterm update in April with an additional 5,000 listings.

The AWI *Surface Mount Component Library* is a spiral-bound compilation with a complete listing of about 12,000 surface-mountable active components and sells for $350. Each component is listed by generic part number, manufacturer part number, description, and package type. The AWI book does not list passive parts but does list manufacturers of these components.

will soon introduce several large memories in 18-pin plastic leaded chip carriers and gate arrays in 68- and 84-leaded J-type plastic leaded chip carriers.

But the very diversity of SMD packages is causing problems for the emerging technology. John Orcutt, director of engineering for the Microelectronics Division of the Allen-Bradley Co., Milwaukee, points out that a potential user of SMD technology faces a confusing task of choosing the right package.

He notes that formerly, just one DIP standard controlled 90% of the plastic packages used worldwide. Surface-mounting assembly, on the other hand, offers 13 different package standards. Obviously, industrywide simplification must take place, otherwise users and placement-machine manufacturers face difficult times.

As very large-scale ICs—with lead counts of greater than 84—become more prevalent, most experts seem to think that direct attachment of tape-bonded or wire-bonded chips to pc boards will be the next step in surface-mount assembly.

Chips and DIPs

After semiconductors, the next most heavily used surface-mounted components are resistive and capacitive chips. In fact, many companies take their first stab at surface-mounting assembly by substituting passive chips for the usual leaded components, and stick to DIPs for ICs. Most passive chip components had already been developed for use in thick- and thin-film hybrid circuitry.

The dominant resistor for SMA is the leadless-chip type (Fig. 4). At least 20 companies worldwide offer this part, including Allen-Bradley, Mepco-Electra, Dale Electronics, and Stackpole in the U.S.; Siemens and Philips in Europe; and Kyocera, Rohm, and Panasonic in Japan. These units are built on alumina substrates with an inner electrode and usually a ruthenium thick-film material (thin-film types are also available). A nickel barrier that is placed between the inner electrode and the solder coating keeps the electrode from leaching during solder reflow.

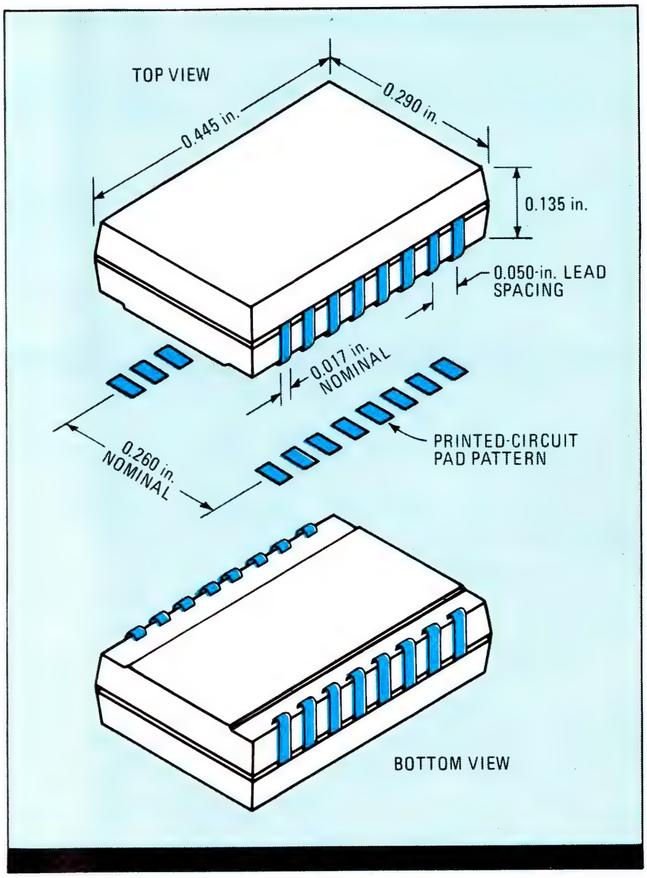
These chip resistors range from 10 to 2.2 MΩ, with tolerances of ±1%, ±2%, ±5%, and ±10% and power ratings of 1/16, ⅛, and ¼ W. Typical packages are: the 1206, a 3.2-by-1.6-mm unit that can be either flat or Melf type; the 0805, a 2-by-1.4-mm type; and the 1210, a 3.2-by-2.6-mm type.

TABLE 2: SMALL-OUTLINE AND SMALL-OUTLINE-LARGE PACKAGES VS. DIPs

Package feature	8-pin		14-pin		16-pin		16-pin L		20-pin	
	SO	DIP	SO	DIP	SO	DIP	SOL	DIP	SOL	DIP
Body size (in.):										
Length	0.197	0.375	0.344	0.755	0.394	0.755	0.413	0.755	0.512	1.060
Width	0.157	0.252	0.157	0.252	0.157	0.252	0.299	0.252	0.299	0.252
Board area (in.):										
Length	0.197	0.375	0.344	0.755	0.394	0.755	0.413	0.755	0.512	1.066
Width	0.244	0.310	0.244	0.310	0.244	0.310	0.419	0.310	0.419	0.310
Area	0.048	0.116	0.084	0.234	0.096	0.234	0.173	0.234	0.214	0.330
Body thickness (in.):	0.057	0.125	0.057	0.125	0.057	0.125	0.097	0.125	0.097	0.145
Height above pc board:										
Board (in.)	0.069	0.155	0.069	0.155	0.069	0.155	0.104	0.180	0.104	0.180
Weight (mg)	60	600	114	1,050	130	1,200	400	1,200	500	1,500

SOURCE: SIGNETICS CORP.

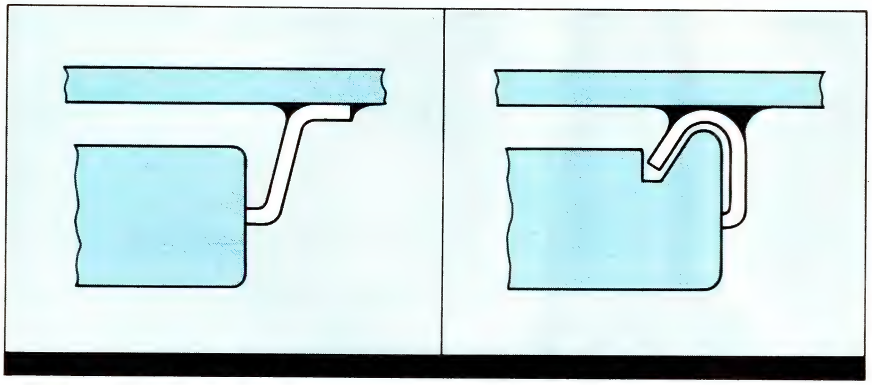
These chips are usually packaged on reels of 8-mm tape (either paper or embossed plastic barrier) for use on automatic-placement machines. Or they are packaged in bulk or in magazines. Many of the smaller chips are supplied in bulk and fed from vibratory feeders on some of the newer pick-and-place machines.



2. The leader. The small-outline J-lead package is typical of what many experts expect to be a de facto standard by the late 1980s. Gnostic Concepts Inc. predicts that by 1988 the SOIC package will be used in 45% of all surface-mounting applications.

At the January 1985 Electronic Industries Association's Surface Mount and Reflow Technology Seminar, Mark McCabe, product-engineering manager for surface-mounted devices for Dale Electronics Inc., Columbus, Neb., listed five user considerations for the application of chip resistors:

- The type of mounting used.
- The soldering temperature and times.
- The amount of power dissipated.
- The prevention of tombstoning (a situation in which



3. Battle of the leads. The gull wing (left) is currently the most popular lead geometry for the SOT-23, SOIC, and the Japanese quad flat pack. The J-lead (right), used mainly on plastic chip carriers, has a smaller footprint, can be handled automatically, and is easily cleaned.

chip components are made to stand up during in-line reflow soldering).

- The compatibility between the device and the board material in regard to the thermal coefficient of expansion.

Surface-mounted resistor networks for use as pull-up, pull-down, and terminations are also available in thick- and thin-film types packaged in ceramic and plastic DIPs as well as in flat packs. Recently, resistive networks have become available in both SOT-23 and leadless ceramic chip-carrier packages from both Dale and CTS Corp., Elkhart, Ind.

Other resistive components available for surface mounting are small trimmer potentiometers from Kyocera and CTS. The Kyocera parts, which are 150 by 177 mils, are based on a cermet resistive element; they come in values from 100 Ω to 1 MΩ and in reels of 12-mm tape or in bulk. The CTS unit is in the prototype stage.

Capacitors and inductors

Surface-mountable capacitors fall into three categories—multilayer ceramic chip capacitors, solid tantalum capacitors, and aluminum electrolytic chip capacitors. The multilayer ceramic type fills some 81% of all surface-mounted applications. At least 12 companies worldwide, led by AVX Corp., Myrtle Beach, S.C., supply these capacitors.

A multilayer capacitor (Fig. 5) is effectively many capacitors connected in parallel. Precious-metal electrodes are stacked alternately with layers of ceramic dielectric. At each end of the capacitor, metallization interconnects the exposed edges of the electrodes.

These parts feature high capacitance per unit volume, good temperature stability, excellent resistance to humidity, and high reliability. Capacitance values range from 1 pF to 1 µF. This type of component comes in the same square chips or Melfs as the chip resistor and usually on 8-mm tape.

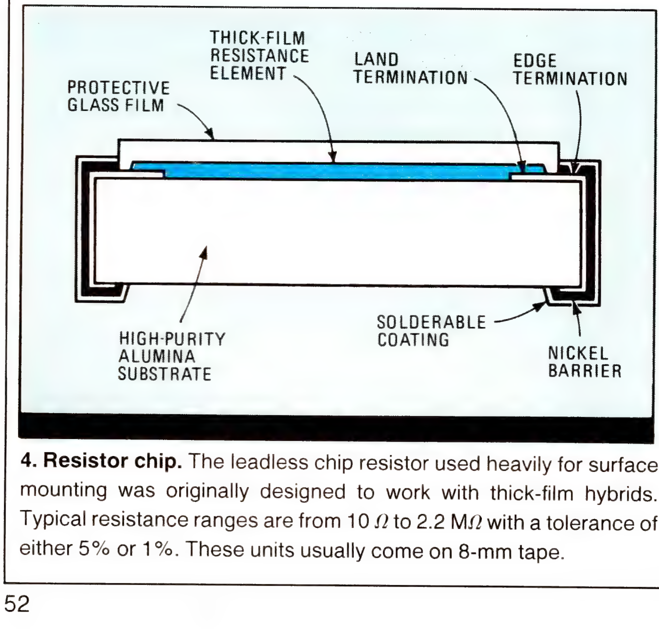
For applications requiring greater capacitance, solid tantalum chip capacitors or aluminum electrolytic chip capacitors can be used. Tantalum chips can have a capacitance of 0.1 to 100 µF. Aluminum electrolytic chip capacitors can be supplied in values from 1.5 to 47 µF but are larger than the tantalum types. Both of these types can be supplied on either 8- or 12-mm tape.

Toroidal transformers

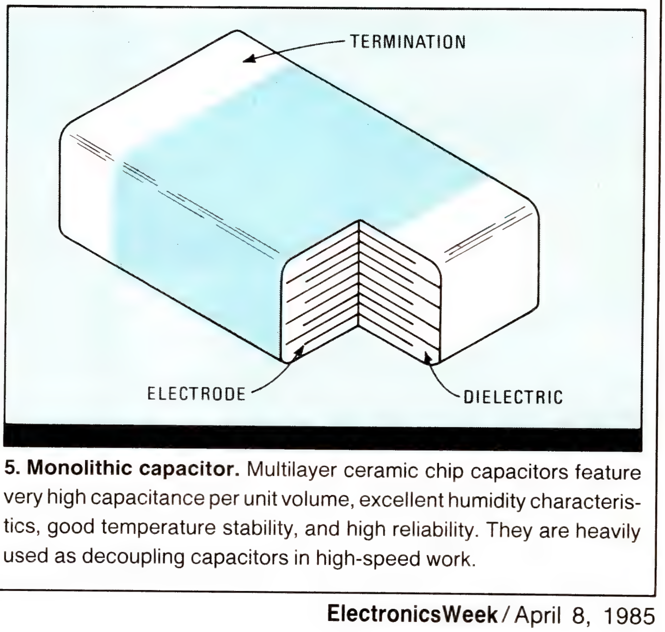
At least 12 companies in the U.S., Japan, and Europe manufacture chip inductors and toroidal transformers. Inductance values that range from tens of nanohenries to one millihenry can be packaged easily in these chip components.

For example, West-Cap Arizona, Tucson, a subsidiary of SFE Technologies, offers wire-wound inductors in a 120-by-150-by-180-mil leadless package that covers the 0.01- to 1,000-µh range. A larger unit in a ¼-in. cube covers an inductance range of from 1 to 200 µh and can handle currents of 100 mA to 1.5 A.

Technitrol Inc., Philadelphia, has a line of magnetic components suitable for surface mounting. These include chip-carrier delay lines, chip-carrier interface transformers for high-speed serial data-communications systems, chip-carrier pulse transformers, and the leaded 625-mil^2

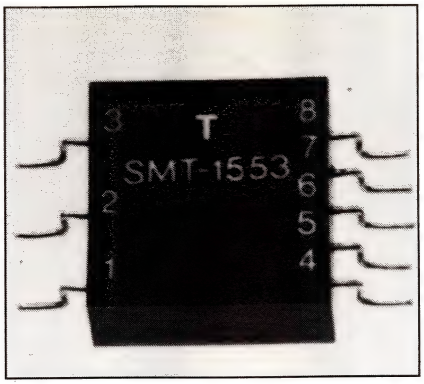


4. Resistor chip. The leadless chip resistor used heavily for surface mounting was originally designed to work with thick-film hybrids. Typical resistance ranges are from 10 Ω to 2.2 MΩ with a tolerance of either 5% or 1%. These units usually come on 8-mm tape.



5. Monolithic capacitor. Multilayer ceramic chip capacitors feature very high capacitance per unit volume, excellent humidity characteristics, good temperature stability, and high reliability. They are heavily used as decoupling capacitors in high-speed work.

data-bus interface transformer, which meets MIL STD 1553 (Fig. 6).

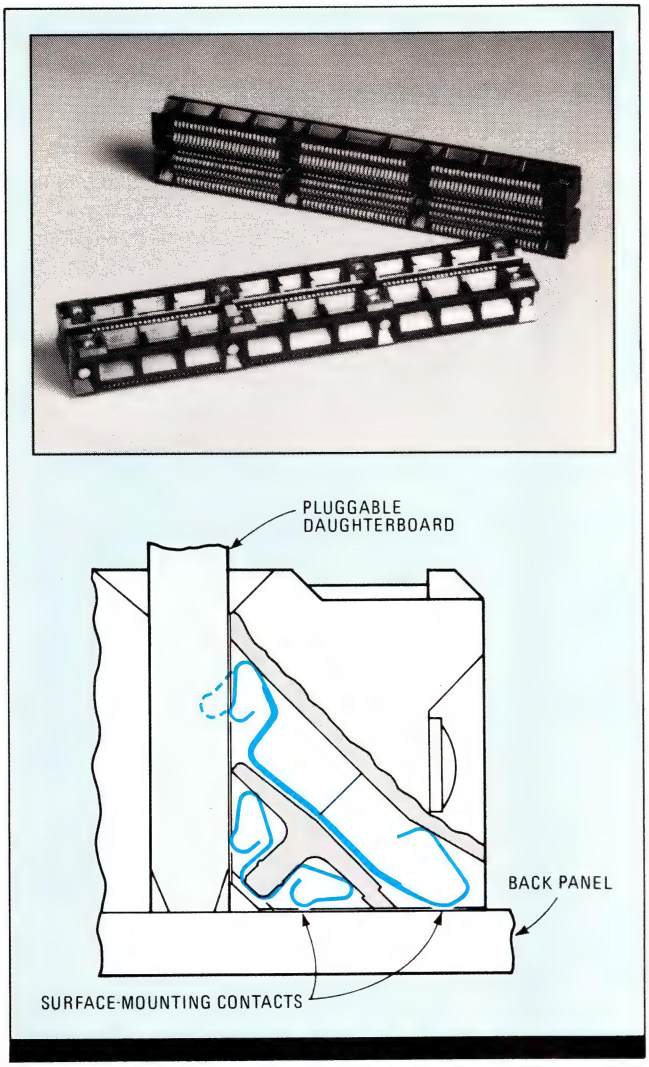


6. Surface-mounted interface. One of the newest surface-mountable components is the MIL-STD-1553 data-bus interface transformer from Technitrol Inc. The unit is 625 mil^2 by 275 mils high with gull-wing formed leads. A flat-pack version is also available.

Currently, several major U.S. connector firms—such as Burndy, Amp, and DuPont Connector Systems—have developed or are working on surface-mounted card and backplane connectors along with IC sockets. Many of these connectors are adaptations of older connectors with J- or L-shaped leads for reflow soldering to a pc board.

Burndy Corp., Norwalk, Conn., on the other hand, has taken two approaches to surface-mounted connectors. One is similar to its competitors' shaped-lead method. The Burndy designs, however, often have molded guide pins in the connector's plastic housing; these align connector contacts against the pc pads.

The firm also takes a solderless approach based on a pressure-tight connection. An example of this type of connector is Burndy's Surfmate, an extremely high-density card-edge connector that packs 318 contacts in a 5.09-in. housing (Fig. 7). It consists of two sections, each with 159 contacts. The contacts are located on a 50-mil pitch in a two-row, staggered layout, providing an effective 25-mil pitch. The four rows of contacts are gold plated to mate properly with opposing gold-plated pads on the daughterboard.



7. Surface-mounted backplane. Burndy's Surfmate connector is a high-density card-edge connector (top) for surface mounting to a backplane. Both the connector and its mating daughterboard use gold-to-gold pressure contacts rather than soldered contacts.

In a typical installation, the connector is first clamped against the pads on the back panel. Then a daughterboard is placed into the connector's slot, engaging spring contacts that mate against pads on the pc board with a pressure-tight connection. This type of connector has applications in high-speed computers: its surface-mounted design shortens interboard wiring lengths, thus lessening propagation delays and crosstalk.

Meanwhile, the rest of the component industry wants to put still other component types into SMD versions. In the switch field, most activity is going into creating an SMD-type DIP switch.

DIP switches are coming

This is not a simple problem, because the component must interface with existing pick-and-place machines and withstand vapor-phase soldering temperatures. Currently, the Electronic Industries Association is working on a standard for an SMD switch. CTS now has a surface-mountable DIP switch in the prototype stage, however, and Augat Alcoswitch, Mansfield, Mass., is tooling the same type of switch. Alcoswitch already has a subminiature toggle switch, the model PSC, that can be surface mounted.

Only one SMD relay has been announced—the highly specialized 9100 reed relay from Coto Corp., Providence, R.I. This unit was a direct result of the need of ATE manufacturers for a small SMD relay that would match a 50-Ω transmission line. The 9100 comes in a J-leaded DIP-like case measuring 0.750 by 150 by 240 in. The unit features a microstrip-type groundplane, which results in a 93-Ω characteristic impedance and contact-to-coil capacitance of less than 1 pF.

Quartz crystals suitable for surface-mount assembly are available from two companies—Statek Corp., Orange, Calif., and McCoy Electronics Corp., Mt. Holly Springs, Pa. The crystals can be supplied in chip form, flat packs, or leadless ceramic chip carriers. Statek can also supply a complete crystal oscillator in a 24-pin ceramic chip carrier.

Other interesting SMA components that have appeared this year are a surface-mountable power-distribution bus from Rogers Corp., Mesa, Ariz. [*Electronics Week*, Feb. 25, 1985, p. 61]; surface-mountable varistors in chip form from General Electric Co.'s Semiconductor Division, Syracuse, N.Y.; and a chip-type optocoupler from Micropac Industries Inc., Garland, Texas. ☐

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MASS STORAGE GETS NEW BOOST

Higher-efficiency encoding schemes for disk storage devices can offer more bits and fewer errors at little or no extra cost

☐ *by Max Roth*

The goal in mass storage has always been to increase capacity at a lower cost per megabyte. But manufacturing presents some constraints—what can be engineered cannot always be produced in volume. Currently, only three techniques produce higher Winchester capacities. When Winchester disks evolve to higher capacities, their designers generally use one of these techniques in the development cycle.

The first solution, which is direct but inelegant, is to add more disks and heads, resulting in higher cost without improving either head or medium technology. The second solution is more tracks per inch, now limited to approximately 1,000. Use of a thin-film medium, along with improved servo technology and mechanics, will further increase the number of tracks per inch. This method is less costly than adding heads and disks but requires more development effort.

The third technique is to raise the number of bits per inch. Achieving density greater than 16,000 bits/in. is possible using a thin-film medium, an improved read channel, lower flying height, and run-length-limited (RLL) encoding schemes.

As disk drives approach their mechanical and servo limits, further increases in storage capacity are possible only by increasing bit density. The problem is to select the correct recording code to maximize the areal density (bit density multiplied by track density) for a given signal-to-noise ratio, flying height, medium thickness, and magnetic properties.

Magnetic and code technologies

Data is written on the medium by magnetically saturating it. A change from one polarity of magnetic saturation to its opposite is called a magnetic transition or flux reversal. The magnetic transitions are written and read back by a head flying close to the rotating disk. The data to be written is represented in binary form—the write electronics and the head translate it to magnetic transitions. These magnetic transitions, written on the disk at regular intervals, are based on coding rules (Fig. 1).

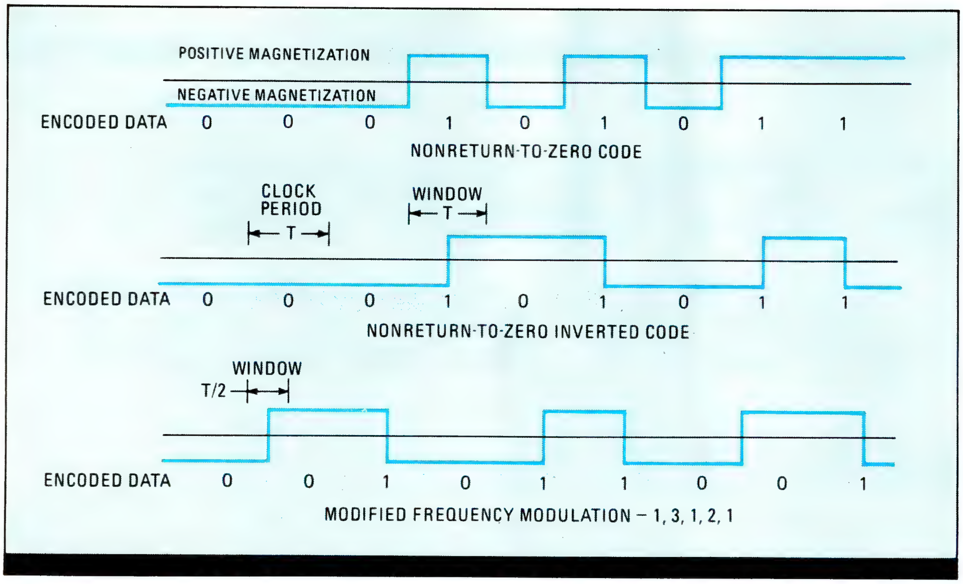
An ideal code will have a minimal number of magnetic transitions for each data bit and will also have a low or zero dc component; it maximizes the time between each magnetic transition and is self clocking. These are called run-length-limited codes because of the limit on the time between two adjacent magnetic transitions (see "Magnet-

ENCODING TECHNIQUES

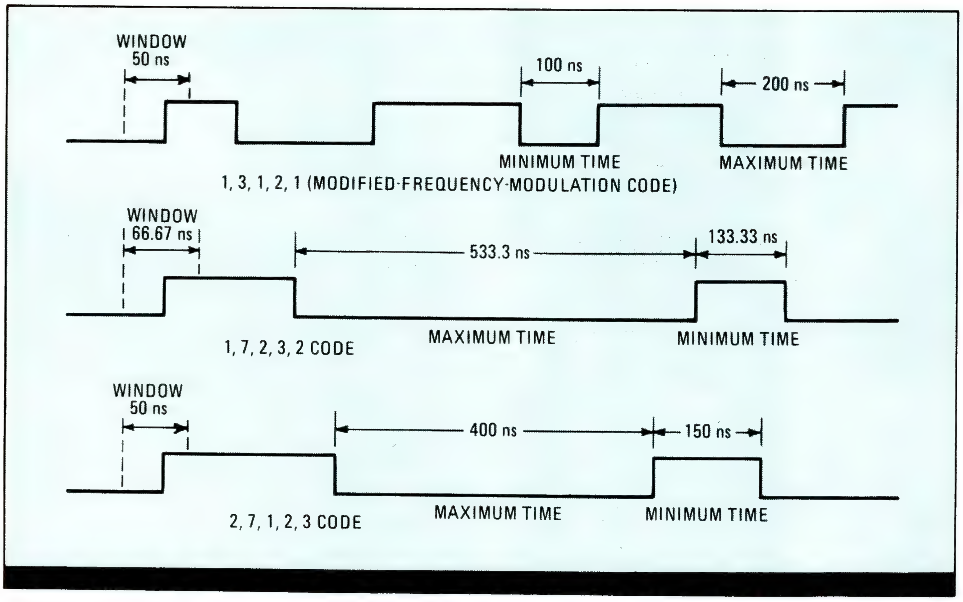
Codes	Parameters								
	P	d	k	m	n	Density ratio	Time between transitions		Window
							minimum	maximum	
Nonreturn-to-zero inverted	∞	0	∞	1	1	1	T	∞	T
4/5 group-coded recording	3	0	2	4	5	0.8	0.8T	2.4T	0.8T
Modified frequency modulation	2	1	3	1	2	1	T	2T	0.5T
2, 7, 1, 2, 3	2.67	2	7	1	2	1.5	1.5T	4T	0.5T
1, 7, 2, 3, 2	4	1	7	2	3	1.33	1.33T	5.33T	0.67T
1, 6, 2, 3, 4	3.5	1	6	2	3	1.33	1.33T	4.67T	0.67T

P = (k + 1)/(d + 1)
d = minimum number of 0s between two adjacent 1s
k = maximum number of 0s between two adjacent 1s

m = number of data bits converted into n code bits
n = number of code bits converted from m data bits
T = clock time


POSITIVE MAGNETIZATION
NEGATIVE MAGNETIZATION
ENCODED DATA 0 0 0 1 0 1 0 1 1
NONRETURN-TO-ZERO CODE
CLOCK PERIOD
T
WINDOW
T
ENCODED DATA 0 0 0 1 0 1 0 1 1
NONRETURN-TO-ZERO INVERTED CODE
WINDOW
T/2
ENCODED DATA 0 0 1 0 1 1 0 0 1
MODIFIED FREQUENCY MODULATION – 1, 3, 1, 2, 1

1. Basic codes. Three types of coding show data transitions between positive and negative magnetization. The width of the window determines the time in which the data can be read, which is tied to the clock period T. If the window is larger, the probability of missing data is smaller.



2. Windows on the world of bits. The window is the amount of time available for the data bits to be read. A wider window decreases the probability of making an error because of pulse jitter, because the extra width ensures that the data bit can still be read, even though it moves.

ic recording and run-length encoding," p. 59).

The definitions proposed by Patel provide a standard of comparison for the different types of codes.* All codes can be described by a five-digit number—d,k,m,n,r, where d is the minimum number of 0s between two adjacent magnetic transitions; k is the maximum number of 0s between two 1s; and m is the number of data bits that are converted into n-code bits to be stored on the disk. Codes where r equals 1 are fixed-length codes; codes with r larger than 1 are variable-length codes. With these parameters, some useful characteristics of the codes can be defined.

Data density defines the number of data bits per magnetic transition. The density ratio (DR) is the ratio between bits per inch and magnetic transitions per inch—a basic measure of code efficiency—and is given by $DR = (m/n)(d+1)$. A higher density ratio means that for a given number of magnetic transitions, more data can be recorded using this code. The density ratio gives the minimum transition interval.

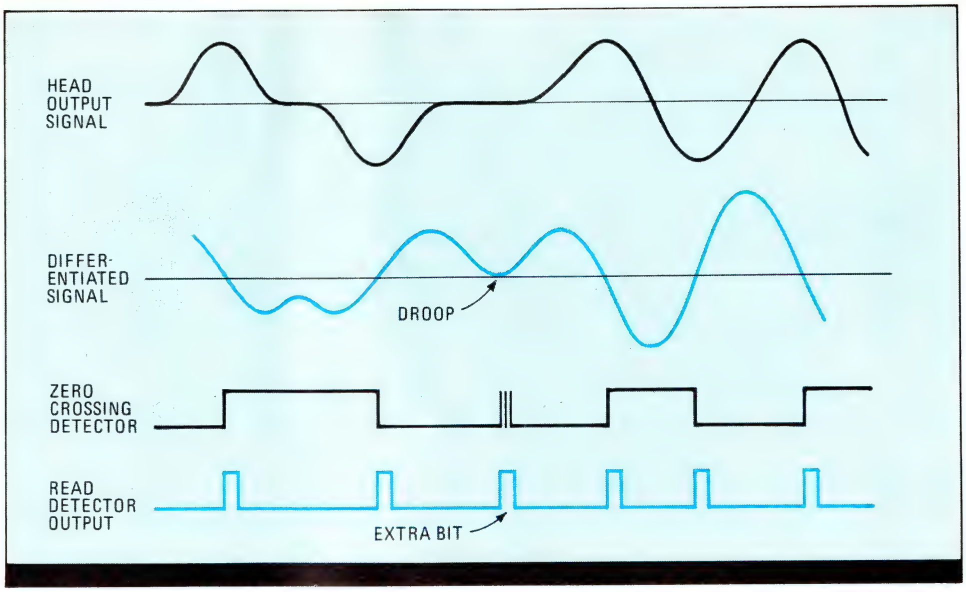
Codes with a high density ratio provide read-back signals with low intersymbol interference (ISI) or peak shift. Codes with a low density ratio require more complex detection circuits requiring a large amount of hardware, which can result in timing errors. A high density ratio limits the peak shift but may affect the jitter of the reclocking and detection circuit.

A code requiring narrow bandwidth is preferable. RLL codes are modulation types; incoming data is encoded with the use of pulse-position modulation techniques. Codes with a high ratio of maximum distance to minimum distance between pulses need a wider spectrum to pass all the components of the read-back signal. Therefore, these require a wider bandwidth.

In addition, a code with wide bandwidth usually contains a high dc component, increasing amplifier settling time and base-line shift. A self-clocking code is mandatory for accurate and reliable detection of the pulses being read from the disk.

Codes with r greater than 1 are more complex. But the implementation of high-quality codes requiring relatively complex circuitry is becoming practical and cost effective, because many of today's chip sets use very large-scale integration.

The code's sensitivity to defects should be considered when selecting the code. In oxide-coated disks, the coating may have to be thicker than desired because of manufacturing difficulties. The coating of magnetic material on the substrate is imperfect—flaws or defects can cause errors in the read-back signal or even the loss of a few bits. It is preferable that the code selected be less sensitive to this type of error. If even a single bit is lost because of medium defects, this error should not propagate for more than a finite number of bits, and this number should be as small as possible.



3. Drooping adds errors. When the read-head output signal of a long train of zeros is differentiated, the generated droop may cross the base line. The zero-crossing detector will pick up these zero crossings and generate spurious additional 1s, causing a read error at that point.

Another parameter is P = (k+1)/(d+1). Codes with high P tend to have high ISI, poor self-clocking capability, and a large dc component.

IBM Corp.'s newest disk drives use the more advanced RLL codes. In the 3370 and 3380 disk drives, the 2,7,1,2,3 code is used; it has a code efficiency of 1.5—that is, 1.5 data bits for each magnetic transition (Table). This characteristic, in conjunction with its self-clocking capability, can increase the bits per inch by 1.5 times the magnetic-transition density. In achieving this, the other factors that must be taken into account are the medium's magnetic properties, the flying height, and the S/N ratio of the read or write channels.

In disk drive systems where ISI limits an increase in bits per inch, this code gives the designer high bits per inch for relatively low magnetic-transition density, hence low adjacent transition interaction.

In magnetic recording, one way to define the performance of the head and medium interface is to measure the width of the read-back pulse at 50% of its amplitude. This is known as PW50 and can be expressed by the formula PW50 = $g^2+4(h+a)(h+a+\delta)$, where g is gap length, h is flying height, a is transition length, and δ is medium thickness. Parameter "a" depends on the medium's magnetic properties and is closely related to the flying height. The mechanical parameters g, h, and δ refer to the head and medium.

Because of imperfections in the oxide coating, at high linear densities the read-back pulse is not narrow enough and could interact with its neighbor, causing ISI. Therefore, codes with a large value of d are better because they offer more 0s between two adjacent 1s.

In the IBM 3370 and 3380 disk drives, the oxide medium is about 25 μin. thick. Pulse interaction is the major limiting factor in increasing the bits per inch if the code to be used is modified frequency modulation (MFM). The 2,7,1,2,3 code was selected because it has a larger value of d.

Importance of code

Reducing the flying height is another way to achieve small PW50 for less pulse interaction. For the 5¼-in. disk drive, however, where the figure of merit = capacity/(cost)(access time), reducing the flying height can make the drive less reliable, consequently increasing its cost. The designer of the 5¼-in. disk drive can better increase capacity or cost with the coding rather than reducing the flying height.

Selecting the right code then becomes as important as selecting the right head and medium. If the correct code is selected, the drive may be able to withstand more off-track errors. Because off-track errors are a function of temperature, the drive could operate through a wider temperature range without making read errors.

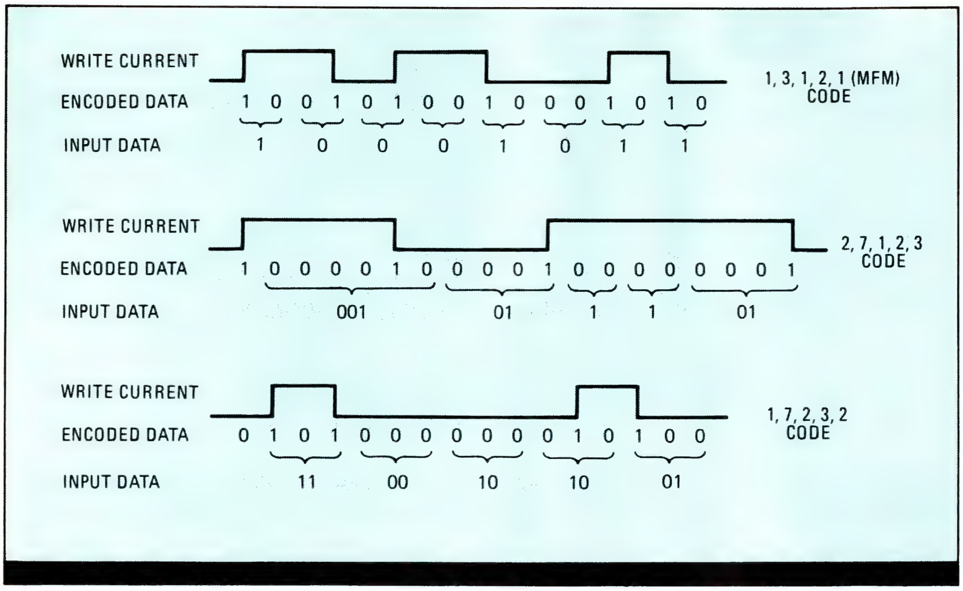
The first step in selecting the code is finding the PW50 and the S/N ratio from the read head. By knowing PW50, the extent of the interaction between two adjacent pulses, called ISI, can be estimated. The S/N ratio for this density can be found by knowing the bandwidth (a function of the code chosen), then measuring the S/N ratio with a spectrum analyzer. The higher the bit density, the higher the channel bandwidth will be for a given disk rotation speed. ISI decreases as the bandwidth increases, while the S/N ratio increases.

Detection window

Another major consideration is the detection window that the read detector sets based on the code that has been written. If a bit is detected within the window limit, it is considered to be a 1. An error occurs when a bit falls outside the window. For the read/write design engineer, codes with a larger detection window are better because they can tolerate a larger pulse jitter than codes with narrow windows can. The pulse jitter is a function of the S/N ratio, overwrite, adjacent track interference, detector phase-locked-loop jitter, and instantaneous speed variations of the spindle motor.

The nonreturn-to-zero-inverted (NRZI) code has the largest window, so it can tolerate more ISI and more noise (Table 1). Group-code recording gives a large window, but its efficiency is lower than NRZI and MFM. Crowding the 1s together can compensate, but then the ISI increases to the point of diminishing returns.

The 1,7,2,3,2 and the 2,7,1,2,3 RLL codes offer the best compromise between ISI and S/N ratio. Both have a high density ratio so that the designer can use a low magnetic-transition density for a given number of bits per inch, reducing the ISI accordingly. But one code is not necessarily better than the other. The 1,7,2,3,2 code, however, offers a wider detection window for a given



4. More bits. Various codes have different encoding and decoding characteristics. The modified frequency-modulation code, for example, has a maximum of three 0s between successive 1s. The 2,7 code, however, has a maximum of seven 0s between successive 1s.

number of bits per inch, decreasing the probability of making an error because of pulse jitter (Fig. 2).

Pulse jitter is a combination of pattern-induced peak shift, T_p, and noise-induced peak shift, T_n. T_p is caused by interaction between adjacent magnetic transitions and reaches its maximum value for the worst-case pattern of each code. T_n is caused by noise jitter because of disk noise, head noise, read-amplifier noise, and overwrite. The highest recording density for each code can be defined as the density where the total peak shift T_p plus T_n equals the detection window width T_w.

T_p is not a linear function of the adjacent magnetic transition crowding; it increases rapidly as the transitions get closer. T_n, however, is fixed for a given code and recording system. Phase margin $T_m = T_w - T_p - T_n$ is commonly specified as a measure of the quality of the disk-drive recording system. For disk systems where PW50 is small, such as in drives using a thin-film medium, T_m is closely tied to T_n. The larger T_w is, for a given T_p and T_n, the larger T_m becomes.

Defects

One of the least known and the least controllable parameters that affects the drive's bit error rate is the effect of medium defects. Thin-film medium has more single-bit, or micro, defects than oxide. These defects could affect the drive's bit error rate if the drive manufacturer did not detect and flag them before shipping the drive. Codes with larger T_w can tolerate more peak shift caused by defects, noise, and ISI than codes with smaller T_w. Furthermore, production tolerances could be made less stringent, raising the overall drive manufacturing yield and reducing drive cost.

In the read channel's design, special attention should be paid to the possibility of false detection. The 1,7 code as well as the 2,7 code have a wider bandwidth than MFM, which means that random data transitions could be written at the maximum distance allowed by code rules—in both cases, up to seven 0s between two 1s. In peak detectors using a differentiator and a zero crossing circuit, an extra 1 could be generated because of the droop in the signal for a long chain of 0s, causing a read error (Fig. 3).

Compared with MFM, 1,7 and 2,7 are encoded and decoded not bit by bit but rather by multiple bits at once (Fig. 4). In MFM, if the bit falls outside the window, one bit error occurs. These errors can be flagged by a cyclic-redundancy-code check for every disk sector. This is valid because the probability of having one error per 2,064 data bits, for a 10^{-10} bit error rate is $P\ (1\ \text{error}) = 2064 \times 10^{-10} (1-10^{-10})^{2064} = 2.063999 \times 10^{-7}$. The probability of more than one error is $P\ (1\ \text{error}) = 1-(1-10^{-10})^{2064} = 2.064 \times 10^{-7}$; the two results are virtually the same.

With the 1,7 and 2,7 codes, if one bit is misplaced in the data stream, up to 5 bits in the 2,7 code and 6 bits in the 1,7 code could be read as an error. The drive designer should be aware of this and define the bit error rate accordingly. An alternative is to quote a bit error rate in burst length per X bits transferred.

The effect on the controller is evident. A more elaborate error-correcting code should be implemented in future controllers. Then the error rate will become low, provided that the length of the error burst from the drive decoder does not mask the error-correcting code's capabilities. The problem of specifying the raw error rate from the drive then becomes more a matter of definition when the drive is used with a smart controller. The error rate figure can then be limited to the error rate seen at the controller output.

The preferred way to achieve higher capacity is to select run-length encoding to increase the disk areal density. Using a direct method of more disks and heads or a servo or mechanical approach to increase tracks per inch reduces reliability and increases product cost. Increasing bits per inch also increases drive manufacturing yield with the lowest drive cost.

In the future, as the demand for capacity increases, more efficient codes will become important in attaining the desired densities. Efficient codes offer the best solution for upgrading disk drives without requiring changes in heads or medium technology. Yet raw bit error rate cannot be specified in the same way as for current drives. Users will have to include smart controllers with more powerful error-correcting codes to correct the recording code errors generated. ☐

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*Arvind M. Patel, "Zero-modulation Encoding in Magnetic Recording," *IBM Journal of Research & Development*, Vol. l9, No. 4, July l975, pp. 336-378.

Max Roth is manager of advanced development at Vertex Peripherals Inc., Milpitas, Calif.

Magnetic recording and run-length encoding

To read the stored magnetic transitions on the disk, the binary data can be recovered by reconstructing it from the read-back signal picked up by the magnetic head. The magnetic transitions should be placed as close together as possible so that the disk surface is used more efficiently, permitting storage of more flux changes per inch.

According to magnetic theory, the magnetic transitions, when read back, appear as a train of pulses shaped like the Gaussian distribution curve: their peaks correspond to the magnetic-transition locations on the disk. Because the read-back process is linear, the read-back waveform can be constructed by superimposing these isolated pulses. As these pulses become closer together, the peaks are moved from their original location, thus causing a condition known as peak shift, or intersymbol interference. This intersymbol interference restricts how closely the encoded magnetic transitions can be packed.

Early disk drives used nonreturn-to-zero code. This code, though simple, lacks the advantages of the run-length-limited codes (RLL). Run-length-limited coding is the mapping of a block of data into a block of code words and recording them on the disk. On the medium, the presence of magnetic transitions represents the binary digit 1 and the absence of magnetic transitions the binary digit 0.

CODING RULES

Data	Code
1, 7, 2, 3, 2 code	
0 1	X 0 0
1 0	0 1 0
1 1	X 0 1
0 0 0 1	X 0 0 0 0 1
0 0 1 0	X 0 0 0 0 0
0 0 1 1	0 1 0 0 0 1
0 0 0 0	0 1 0 0 0 0
1, 3, 1, 2, 1 modified frequency modulation code	
0	X 0
1	0 1
2, 7, 1, 2, 3 code	
0 0 0	0 0 0 1 0 0
1 0	0 1 0 0
0 1 0	1 0 0 1 0 0
0 0 1 0	0 0 1 0 0 1 0 0
1 1	1 0 0 0
0 1 1	0 0 1 0 0 0
0 0 1 1	0 0 0 0 1 0 0 0

X = complement of the preceding bit

For NRZ code, a magnetic transition is recorded for every 1 bit; no change, however, occurs for the 0 bit. Since this code suffers from a substantial dc component, and because the time between adjacent magnetic transitions is unlimited, wide frequency bandwidth requirements may arise. This, in turn, could cause problems for the read and write channels.

Another drawback of the NRZ code is its poor self-clocking property. To overcome this, one technique included the addition of a separate clock track that provided the clock required to decode the data. This solution was uneconomical, however, because of the extra cost for the clock head and the read circuitry.

The modified-frequency-modulation code offered some solutions to the problems encountered in the NRZ code. This code is a true RLL code and is closer to the ideal than the NRZ code. In this code, a magnetic transition is written for each 1 bit; each 0 bit between two 1s is ignored, and a magnetic transition is written at the beginning of the data cell between adjacent pairs of 0s.

A block-coding technique can transform arbitrary binary data into an RLL sequence. However, IBM used the 4,5 group-coded recording in its 3420 tape drive. The recording identifies codes that convert blocks of incoming data, which are then recorded on the disk, and converts a block of four data bits into five code bits. The recording is done using the NRZ-inverted rules. Hence each 1 code bit corresponds to a magnetic transition, with the 0 code bits corresponding to lack of magnetic transition.

For years, disk-drive engineers looked for more efficient methods to increase the recording density without peak-shift restrictions. One way to accomplish this is to narrow the readback pulses by improving the heads and the disk coating's magnetic properties.

In addition, using more efficient recording codes can encode more data by using fewer magnetic transitions. These recording codes are known by the generic name run-length-limited. They encode the data so that the maximum and minimum distance between the magnetic transitions is finite, allowing greater flux changes per inch.

By selecting the right code, the magnetic transitions can be positioned so that the amount of interaction between adjacent pulses is kept low. One RLL code that is popular with disk-drive manufacturers is the 2,7,1,2,3—called 2,7 for short. The 2,7 code has a minimum of two and a maximum of seven 0s between two consecutive 1s.

The two 0s act as a separation zone—a barrier between the two 1s, minimizing pulse interaction. Moreover, because fewer magnetic transitions are written on the disk for any given data, this code has the potential for increasing the data stored for a given magnetic-transition density.

Since the introduction of the 2,7 code, many other RLL codes have been introduced. Some are even more efficient than the 2,7 and offer the disk designer more flexibility in selecting recording components. For example, the 2,3 codes transfer 2 bits of data into 3 bits of code, compared with the 2,7 family, which encodes one bit of data into two bits of code.

Pc MIMIC SITS IN THE LAP

Combining a 3½-in. microfloppy-disk drive with a 25-line LCD screen, Kaypro's IBM PC-compatible weighs just 11 lb

☐ *by Tobias Naegele*

Portable computers—those handy machines that can slide into the average attache case—seem to have unlimited potential. It is largely unrealized potential, however, because the lap-type models suffer from a variety of ills that range from insufficient memories to inadequate screens.

In the words of one expert, portable computers "are just not usable unless they have 25 lines, the storage of an IBM Personal Computer, and complete compatibility with IBM's PC. They've got to have that or they're not viable—usable maybe, but not practical." The expert is David Kay, vice president of Kaypro Corp., one of the pioneers in the portable computer market.

But if Kay didn't think portable personal computers were practical, then his company would not be coming out with the Kaypro 2000, an 11-lb lap-type personal computer. In his opinion, the 2000 is not just a portable; it is a fully configured IBM PC-compatible that just happens to come in a very small package.

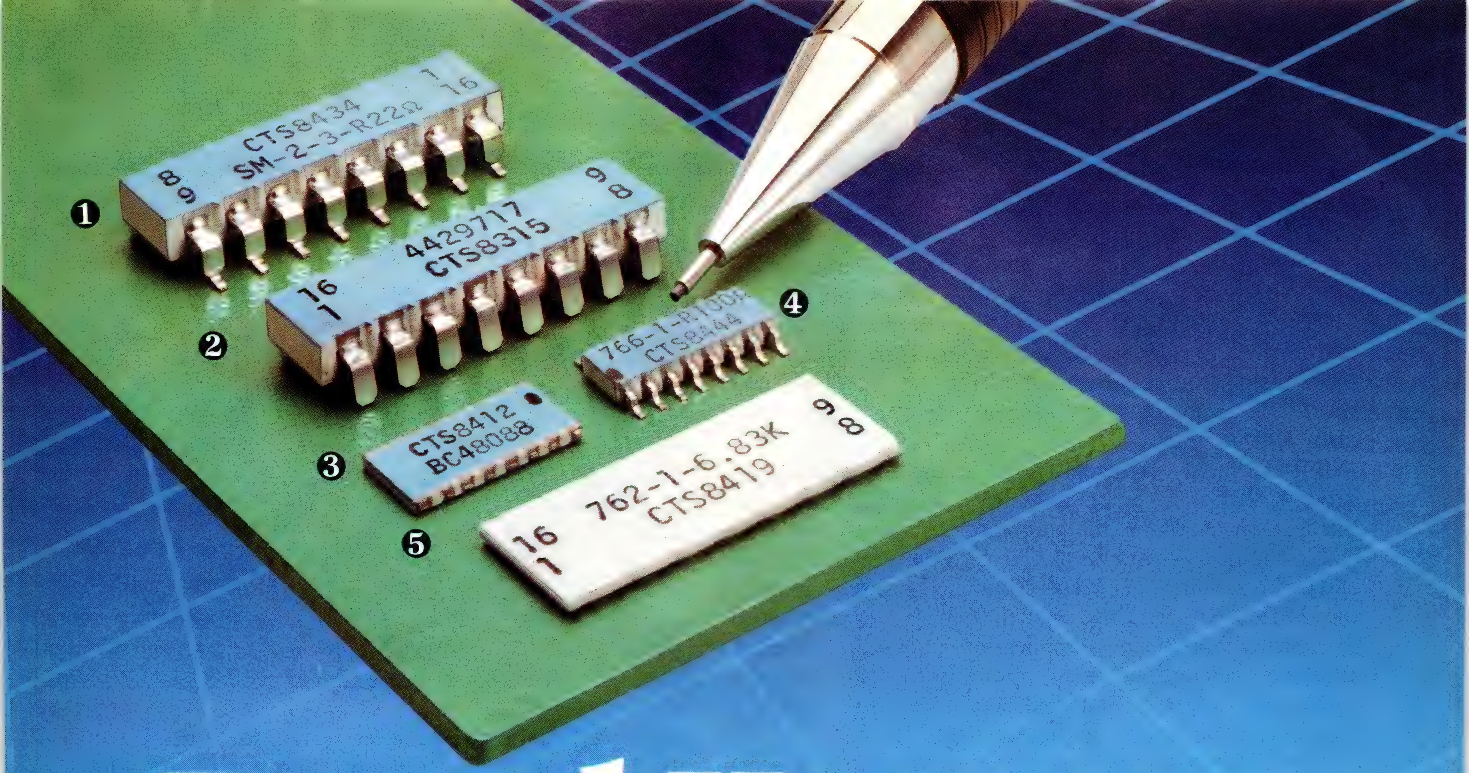
"It has got everything that an IBM PC has except a CRT screen," he says. Indeed, the 2000 offers both ample memory, with 256-K-byte capacity (expandable to 640-K bytes), and an 80-character, 25-line adjustable LCD screen, for only $1,995, significantly less than a similarly configured IBM PC.

A quick price and function comparison between the 2000 and other portables offering similar packages shows that the Kaypro computer stands up well to the competition. Hewlett-Packard Co.'s HP 110 has a built-in modem and weighs 2 lb less than the 2000, but it has a 16-line screen and lists for $1,000 more than the Kaypro. The Apricot Portable from ACT North America comes with a microphone, a mouse, a voice-recognition instrument, and a price tag some $700 heftier than the 2000's. Grid Systems Corp.'s Compass 1100 offers less than half the 2000's storage capacity for well over twice the price.

Measuring 12.5 by 2.6 by 11 in., the 2000 features a 3½-in. microfloppy-disk drive with 720-K bytes of capacity and a rechargeable battery that can power the computer for up to four hours (the user is alerted by an alarm, either audio or visual, when less than one hour of power capacity remains).

Some might balk at the idea of the smaller drive, but Kay can rattle off its advantages faster than most people can load up a 5¼-in. disk. The 3½-in. drive weighs one third that of its standard counterpart, he says, and consumes 30% to 50% less power—an important consideration in a battery-powered machine.

Probably the biggest concern would-be buyers have about the compact 3½-in. microfloppy drives is the availability of software. Kay maintains that they have no need to worry. Most copyrighted software is already available in the 3½-in. format, and Kay promises that Kaypro dealers will be ready and willing to download



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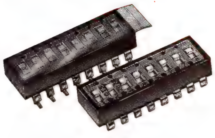

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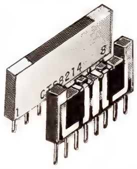

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unprotected software to fit the newfangled format.

"Three-and-a-halfs are here to stay," he predicts. "I wouldn't call [the 5¼-in. drive] a dinosaur, but after two or three years people will go to the 3½-in. format.

"The public intuitively wants to handle a computer like they do a video cassette recorder. They want to toss these disks around." Because of the 3½-in. disk's hard case, it is decidedly more rugged than the larger floppy disk, Kay maintains.

But the main reason Kaypro is using the smaller disk drive is that it takes up less space. The 2000 unit—the third 16-bit computer the company has introduced in the last six months—uses Intel Corp.'s 8088 microprocessor and operates at 4.77 MHz. Standard software includes the MS-DOS operating system, GW-Basic, and word-processing and business-application packages. A socket allows for an optional 8087 math coprocessor for faster computations, and an internal 300/1,200-baud modem is available as an option for under $300.

The LCD screen features a brightness control and can also be adjusted for the user's optimum viewing angle. In addition, the unit's keyboard can be removed from the frame, providing the user with some of the mobility more commonly associated with a desktop, as opposed to a lap-style, computer.

"The white-collar worker—the junior executive, the middle-manager, the supervisor—essentially doesn't need a computer all the time," Kay says. "We're going for the market that doesn't need a computer for but an hour or two a day. Electronic mail, telecommunications, small reports, word processing—that's all that most people really need."

Kaypro Corp., P.O. Box N, Del Mar, Calif. 92014. Phone (619) 481-4300 [Circle reader service number 338]

Smart power chips handle 50 V and switch in 500 ns

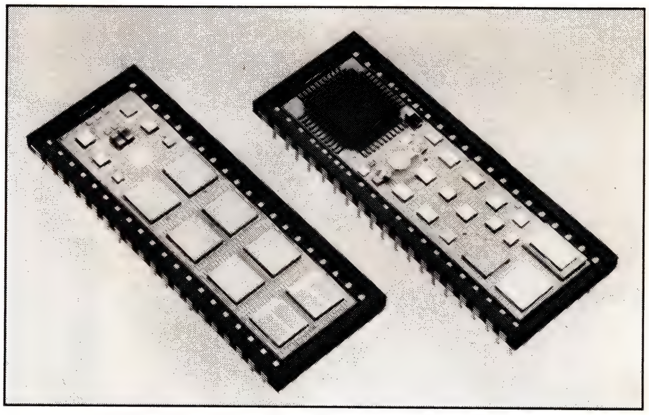
Its first two standard-catalog Smartpower ICs, Siliconix' DG568 and DG569 are targeted at high-voltage multiplexing. Combining logic and high-voltage switching on the same chip, Smartpower ICs provide the designer with an alternative to using many discrete components or expensive hybrids.

These high-power high-speed multiplexers are designed for a ±50-V signal range with true bidirectional capability and low-resistance switching—30 Ω typically. Available with eight channels (the DG568) or as a dual four-channel device (the DG569), the multiplexers with latches have typical turn-off times of 500 ns and are CMOS-compatible.

Built with a combined diffused-MOS and CMOS technology, the Smartpower ICs also feature extremely low switching power consumption. Prices for the DG568 and DG569 are $26.13 each in lots of 100 pieces. They are currently available for both industrial and commercial temperature ranges, and Siliconix will introduce a full military-grade part in the near future.

Siliconix Inc., 2201 Laurelwood Rd., Santa Clara, Calif. 95054. Phone (408) 988-8000 [Circle 341]

Hybrid microcomputer works in temperatures up to +200°C



A hybrid 8-bit microcomputer system, designed for operation in temperatures ranging from –55°C to +200°C, includes an 8085 microprocessor, a crystal clock oscillator, buffering, a universal asynchronous receiver transmitter, 2-K bytes of RAM, and 2-K bytes of PROM. The CMOS hybrid, model DHC8-P85, is housed in a 40-pin DIP measuring 2 by 0.8 in.

The high-performance programmable asynchronous communications interface provides programmable baud rates from 50 to 9,600 for easy interfacing with devices using the RS-232-C interface. Running from a 5-V supply, the hybrid consumes just 35 mA.

For easier use, the microcomputer has an internal monitor to bring the system up when power is applied. This allows the user to determine how the system operates and to get familiar with it. The monitor can be turned off and the user's software written to any standard 2-K PROM and then debugged. For production use, the manufacturer will copy and install the user's code, if required, so that the system will come up running the customer's software.

For applications requiring more memory, the company offers the DHC8-M16, a 16-K byte static RAM module housed in the same-sized DIP. Delivery of either circuit takes 14 to 16 weeks. The microcomputer sells for $2,400, and the memory module goes for $1,600.

White Technology Inc., 4246 E. Wood St., Phoenix, Ariz. 85040. Phone (602) 437-1520 [Circle 340]

Enhanced computers have better Boolean processing

Two new 16-bit devices have been added to NEC Electroncs Inc.'s 7800 series of single-chip microcomputers. The 78P09 features 8-K bytes of on-board EPROM, while the 78C11 is a CMOS version of the firm's 7811 n-MOS part.

The 78C11 has a ultralow-power mode for stop and halt besides the normal power savings of CMOS. Both 7809 parts have improved bus-control signals and better Boolean processing than the firm's 7800 parts.

The 78P09 features 256 bytes of RAM, 40 general-purpose I/O lines, 16 internal registers, 1-μs minimum instruction execution time, an 8-bit comparator port with ±100 mV accuracy, a full-duplex universal synchronous/asynchronous receiver/transmitter, three general-purpose timer/counters, and a 12-bit watchdog timer.

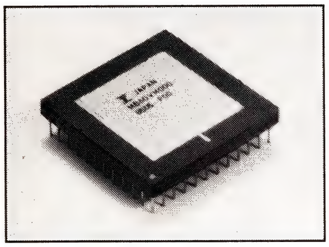
The 78C11 has 4-K bytes of ROM, 256 bytes of RAM, and 44 I/O lines as well as 16 internal registers, an 8-bit analog-to-digital converter, a full-duplex USART, and a 16-bit data bus. It has a 1-μs instruction time, but a high-speed version is available with 800-ns instruction time.

The 78P09, to be available in May, will sell for $150 each in lots of 100 pieces. The 78C11, priced according to the complexity of the masking requirements, will be available in August.

NEC Electronics Inc., 401 Ellis St., Mountain View, Calif. 94039.
Phone (415) 960-6000 [Circle 343]

2,375-gate CMOS array also has 1-K of RAM on chip

A 2,375-gate CMOS gate array also carries 1-K RAM on chip. The RAM can be configured as 256 4-bit words, 128 bytes, 64 16-bit words, or 32 32-bit words and can be interconnected with gates in the array to form a variety of logic-plus-RAM configurations.



The C2300VM is supported by the manufacturer's computer-aided design system, which performs complete dynamic logic simulation and automatic cell placement and interconnection. Only logic and test information is required from the purchaser.

Fabricated in double-layer metal, silicon-gate CMOS technology, the C2300VM offers typical 2.2-ns gate delays and 100-mW power dissipation per chip at 10 MHz. It is available in DIPs and pin-grid-array packages. Production quantities will be available later in the second quarter. Prices vary according to customer requirements.

Fujitsu Microelectronics Inc., Integrated Circuits Division, 3320 Scott Blvd., Santa Clara, Calif. 95054.
Phone (408) 727-1700 [Circle 342]

Scanner's software inputs text along with graphics

Out of the 10,000-odd computer-aided-design sites served by the top six CAD manufacturers, 30% are candidates for scanning facilities, according to Roger Paradis, president of Skantek Corp., which makes the SK-1010 digitizing scanner. This month, the firm will demonstrate a new release of optical-character-recognition software for the SK-1010 at the National Computer Graphics Association show.

The software, called SK-401, boosts productivity by a factor of four by drastically reducing the editing time required at the work station itself, says the manufacturer. This is because the software package, which reads hand-lettered characters, enables the SK-1010 scanner to read and digitize a drawing's text and graphics simultaneously. The job of reentering the text portion into the scanned drawing file at the keyboard is eliminated.

Engineers analyzed over 60 personal lettering styles, along with two common machine-set block-letter faces, to create a knowledge base for the SK-401 software. At the next step, the company speeded up the software's three essential algorithms so that it could process 2,000 characters in 15 min, the same length of time it takes a basic SK-1010 scanner to convert a medium-density drawing's graphic data to CAD/vector form.

Characters are output in ASCII-coded strings in the text file, or layer, as the graphics layer is vectorized. Punctuation and characters ranging in size from 3 to 128 pixels square can be read. The string is then converted to International Graphics Exchange Standard, the Cadam Inc. standard, or the firm's own SK-1010 CAD system-specific formats, and then written to magnetic tape for transfer into the CAD/computer-aided-engineering editing system. Ambiguous characters are highlighted in a separate file for operator editing.

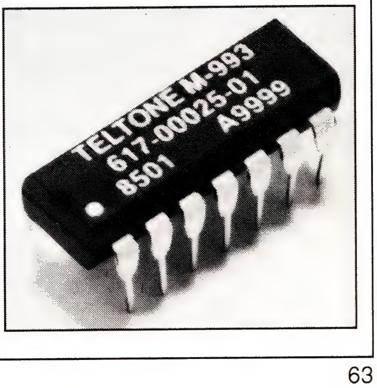
The SK-401 software is joined to the four preexisting subsystems that make up the SK-1010 digitizing scanner: the hardware, consisting of the scanning electronic processor with its stationary fiber-optic scan head that digitizes with a resolution of 254 dots/in.; the 32-bit microprocessor, running in C language under AT&T Bell Laboratories' Unix operating system; magnetic-tape storage; and a touch-screen control unit. The SK-1010 runs as a free-standing peripheral.

The price of the SK-1010 ranges from $125,000 to $140,000, depending on the software options chosen. If the SK-401 OCR capability is added, the price is $165,000; as an enhancement to preexisting systems, the SK-401 software costs $25,000. Volume discounts are available, and delivery time will be quoted depending on the user's preferred configuration.

Skantek Corp., 150 Mount Bethel Rd., Warren, N.J. 07060.
Phone (201) 647-7747 [Circle 372]

Tone generator meets CCITT and AT&T demands

Generating signals that conform to CCITT R1 recommendations and to AT&T MF standards, the M-993 CMOS tone generator is packaged in a 14-pin dual in-line package, for a combination of low-power and space requirements. Tone pairs that signal the telephone trunk line are generated in combinations of 700, 900, 1,100, 1,300, 1,500, and 1,700 Hz, by means of a 3.58-MHz crystal time base. In



quantities of 250, the M-993 multifrequency tone generator is priced at $15 each, with delivery made four weeks after receipt of order.

Teltone Corp., 10801 120th Ave. N.E., Kirkland, Wash. 98033. Phone (800) 227-3800, ext. 1130 (in Washington State, [206] 827-9626, ext. 437) [Circle 359]

Under-$100 modem meets Bell 212A standard

A single-chip modem, the model μA212A, performs all signal-processing functions required for a Bell 212A/103-compatible modem. It incorporates an on-chip switched-capacitor modulator, digital coherent demodulator, switched-capacitor filters, 3.6864-MHz crystal oscillator, call-progress detection, and certain control and self-test functions. Capable of accommodating both high- and low-speed data rates, the μA212A incorporates separate modulators and demodulators for the 0-to-300- and 1,200-b/s rates.

To form a complete system, the μA212A requires only a general-purpose single-chip microcomputer to handle dialing, handshaking protocols, and mode-control functions; it needs only minimal external circuitry to handle the RS-232-C interface, ring detection, telephone-line interface, and power supplies.

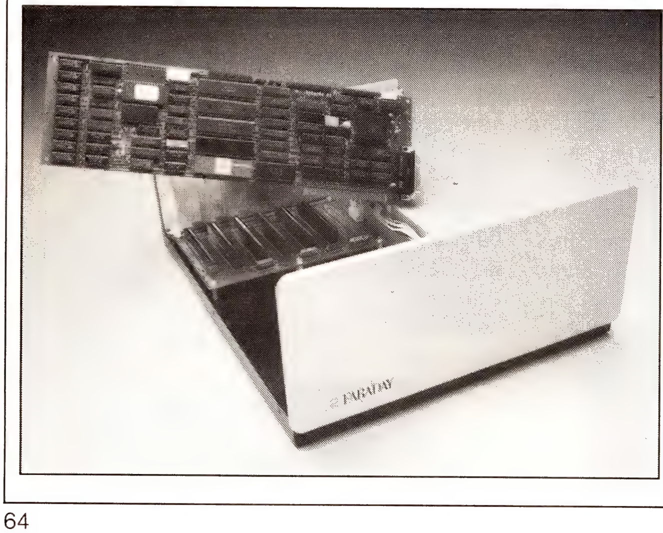
The modem chip can be designed into portable and lap-type computers for integration of a high-speed modem on the motherboard; or it can function in stand-alone modems whose manufacturers are seeking to decrease cost and size by reducing the parts count.

The μA212A modem, whose price is projected at $82.67 in 100-piece quantities, will be available in the second quarter of 1985.

Fairchild Camera & Instrument Corp., 464 Ellis St., Drawer 7281, Mountain View, Calif. 94039. Phone (415) 962-5011 [Circle 358]

Computer board functions identically to the IBM PC

A plug-in single-board computer that is functionally identical to the IBM Corp. Personal Computer, the Bus PC is half the size of the standard PC motherboard. The 4.2-by-13.15-in. multilayered board features an 8088 CPU (with an optional 8087 math coprocessor), 256-K bytes of parity-checked RAM, and 64-K bytes of user EPROM space.



A trio of timer channels and four direct-memory-access channels are also on board, along with a parallel port, an RS-232-C serial port, an RS-232-C or RS-422 selectable serial port, and ports for a speaker and an IBM or compatible keyboard.

The Bus PC supports MS-DOS, Concurrent PC-DOS, VRTX, and AT&T Bell Laboratories' Unix operating systems; it is fully tested. Available now, the $695 computer board features a one-year warranty.

Faraday Electronics, 743 Pastoria Ave., Sunnyvale, Calif. 94086. Phone (408) 749-1900 [Circle 346]

Single-board computer can operate from −40°C to +85°C

The all-CMOS, single-board 8810 computer needs just 100-mA power for high-speed 5-MHz processing—equal in speed, the company says, to its earlier STD bus board with an n-MOS 8088.

The board can withstand temperatures from −40°C to +85°C, and it has a 48-K-byte memory capacity that is configurable in combinations of RAM and EPROM. Three 28-pin memory sockets accept most Jedec-compatible 24- and 28-pin memories.

On-board peripheral functions include a nine-line interrupt controller, a counter/timer consisting of three programmable 16-bit counters, an 8252 serial interface, and an 8-bit parallel I/O port. Capable of operating as a stand-alone unit using only on-board memory and peripherals, the 8810 also features an expansion connector compatible with Intel Corp.'s iSBX modules.

Serial-interface CMOS signal levels can be converted to RS-232-C, RS-422, or RS-449 levels by smaller boards that can be connected to the 8810 through 10-pin ribbon cables. These connectors are considered well-suited to the industrial environment. Another application for the 8810 would be to link personal computers to the STD bus, the company says.

Two versions are available: the all-CMOS 8810-C is $595 and the older n-MOS 8810 is $395; an 8-MHz version is also available, but in n-MOS only. Delivery is from stock.

Systek, 1023 N. Kellogg St., Kennewick, Wash. 99336.
Phone (509) 735-1200 [Circle 347]

New Dataport release writes Tell-a-graf commands

The latest release of Dataport, Version 5.5, brings Tell-a-graf, a mainframe graphics package, into Dataport's analytical environment, dramatically reducing the effort required to produce graphs.

Dataport's Tell-a-graf interface uses full-screen pick-and-point menus to select graph options for line, bar, pie, and text charts. Dataport then automatically generates Tell-a-graf command and data files to produce the desired graph. Typically, a user points to one or two menu options; then Dataport writes out the 10 or 20 Tell-a-graf commands as well as the graph data.

The program runs on IBM Corp. or compatible mainframes under IBM's VS APL or the manufacturer's enhanced APL*Plus system in the VM/SP environment. It supports analysis of spreadsheet-like tables and also multidimensional data structures.

Other interfaces permit Dataport to access information from such popular microcomputer-based software packages as Focus, Lotus 1-2-3, Visicalc, and Multiplan. Users can store data accessed through these interfaces or create their own files using Dataport's file-folder concept.

The price of the Dataport base product is $14,000. The Tell-a-graf interface sells for $4,000, and other interfaces are priced from $2,000 to $6,000. The company offers 30-day trials of the product.

STSC Inc., 2115 E. Jefferson St., Rockville, Md. 20852.
Phone (301) 984-5000 [Circle 357]

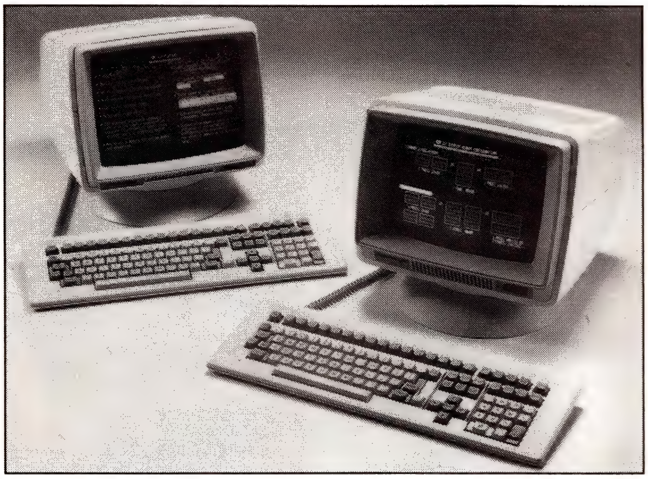
Display terminal gives choice of column formats

With expanded editing and programming features, the ADM 12plus video display terminal offers a choice of either 80- or 132-column display for financial spreadsheet operations.

With programmable cursor keys for word-processing programs such as Wordstar, the ADM 12plus also offers a variable-format display memory and variable-speed vertical and horizontal scrolling. Two pages of 80- or 132-column-by-24-line display memory or a choice of wide- and long-page configurations are also standard. An optional four-page memory is available to double the standard memory formats and add a 158-column-by-48-line display format.

Ergonomically designed, the terminal has 16 programmable function keys (for a total of up to 32 functions) and 400 bytes of function-key memory. An auxiliary port, independently set baud rates, and a choice of a green or amber 12-in. screen is standard.

An optional 14-in. screen is also available. Other options include a 20-mA current loop, an RS-422 interface, and international keycap sets. Available now for immediate delivery, the ADM 12plus terminal is priced at $745 in single quantities.



Lear Seigler Inc., Data Products Division, 901 E. Ball Rd., Anaheim, Calif. 92805. Phone (714) 778-3500 [Circle 349]

Display terminal has 132-column capability

A full 132-column display is now available on Link Technologies' Model 150 video display terminal. The 150, which emulates seven general-purpose ASCII terminals, will feature the 132-column capability in the Televideo 950 emulation mode only.

Two pages of screen memory are provided on the terminal, which features cursor addressing built around Wyse Technology's WY 50 terminal. The dot-matrix resolution in the terminal is 8-by-10 in the 132-column mode, 7-by-10 in the standard 80-column mode.

Users can have older models upgraded for 132-column capability for $100, plus transportation charges; new, the option adds $100 to the terminal's $645 list price.

Wells Data Products International Inc., 1739 S. Douglass, Suite F, Anaheim, Calif. 92806. Phone (714) 634-1333 [Circle 348]

CAD software runs on any VAX linked within Decnet

Thanks to software jointly developed with Digital Equipment Corp., Vaxstation I and Vaxstation 500 systems can be fully integrated as computer-aided-engineering work stations into a network of VAX computer systems using Decnet/Ethernet network products. Called the Design Capture System, the package runs under the MicroVMS operating system and provides electronic designers with tools for advanced design entry. In addition, behavioral simulation and design software for gate-array and standard-cell layout are part of the Integrated Design Environment, which runs under VMS.

The package runs window software for easy manipulation of design information from window to window, from

Vaxstation to Vaxstation, and from Vaxstation to larger VAX computer systems. Using Decnet with a uniform VMS environment, the software establishes a uniform applications and files continuum across the entire network of integrated engineering systems.

Using Decnet, designers can send and receive simulation and analysis results to and from the host processor for postprocessing. A designer has access to the host system's data base for library parts or for other sections of the design.

Pricing was unavailable at press time.

Silvar-Lisco, 1080 Marsh Rd., Menlo Park, Calif. 94025.
Phone (415) 324-0700 [Circle 344]

Package brings CAD tasks into integrated office

A package called the Engineering Support System integrates the engineer's tasks into the general-purpose automated office. The system combines image-processing capabilities of the manufacturer's PIC work station with the computer-aided-design capabilities of Autocad from Autodesk Inc.

Engineers can capture, create, modify, and combine both raster and vector images and then merge them with integrated text to form new documents that serve specific purposes, such as engineering change orders. Documents can be stored, printed, and transmitted to other users at any time.

In addition, the package offers MS-DOS-based personal computing capabilities; emulation of Wang VS, IBM, DEC, and TTY terminals; access to Wang Office functions; and communications over such nets as Wangnet, X.25, and Systems Network Architecture.

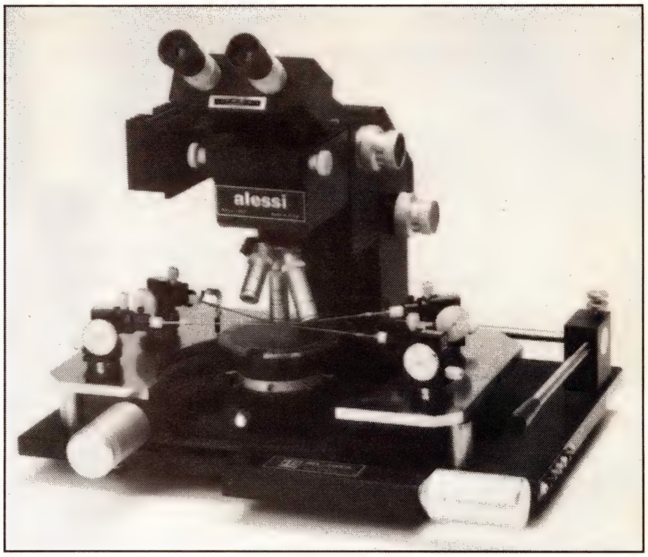
The Engineering Support System's primary components are the PIC image-processing system, priced at $15,935, and the Autocad software, for $2,000. The PIC system features a desktop scanner that digitizes images from sheets of paper and stores them in faster format. A high-resolution monitor and thermal printer (for $2,875) are also available. The system is ready for shipping now.

Wang Laboratories Inc., 1 Industrial Ave., Lowell, Mass. 01851.
Phone (617) 459-5000 [Circle 345]

Test station's positioner is accurate to ±0.0001 in.

Designed for failure analysis, research and development, and quality control, the REL-3200A failure-analysis test station has a precision direct-drive positioning stage with 0.0001-in. accuracy.

The REL-3200A features linear, backlash-free stage positioning that provides 1-μm lines, and a 1-μm digital readout with a 166-location memory. The unit's ½-in.-thick platen/probe ring accommodates up to 12 of the company's micropositioners with either magnetic or vacuum mounts, and its platen lift can be adjusted by the user to as little as 0.2 in.



This allows the operator to simultaneously raise all probes of the device under test, move to the next piece, and repeat the procedure within 2 μm of that same fixed pattern. A slotted vacuum chuck makes wafer loading and unloading operations fast and simple, the company says, reducing worker fatigue. Options include a full line of probe-card holders, ultrasonic cutters, thermal systems, and closed-circuit TV.

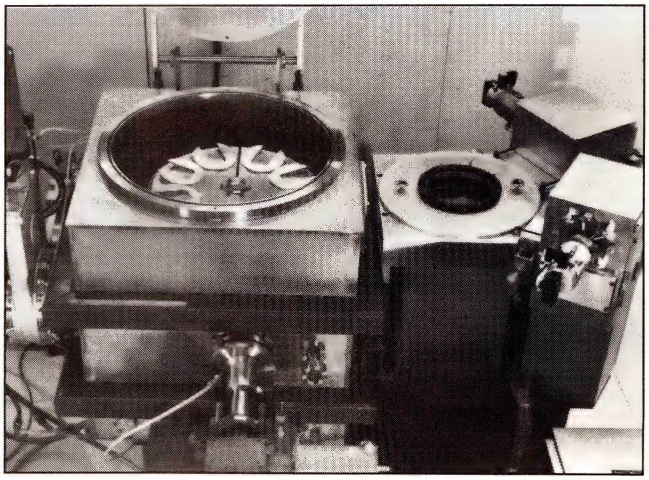
Two versions are available: the REL-3200A, with a 4-in. chuck, costs $9,950, and the REL-3200A-5, with a 5-in. chuck, carries an $11,050 price tag. Delivery takes four weeks.

Alessi Inc., 16871 Noyes Ave., Irvine, Calif. 92714.
Phone (714) 863-0430 [Circle 350]

Ion implanter processes 110 wafers per hour

A high-energy ion-implantation system features up to 3-MeV beams to process wafers without heat. This prevents warping and defines implanted areas better than diffusion methods.

The 1500-25 ion implanter scans mechanically for better than 1% uniformity and can implant up to 110 100-mil wafers/h. Controlled by a touch-screen host comput-



er, the implanter can produce CMOS isolation-well structures, correction, customization, retrograde dopant profiles, barrier layers, and heavy material implants.

Pricing for the unit, which the company says produces virtually undetectable radiation, begins at $950,000, depending on the desired configuration.

General Ionex Corp., 19 Graf Rd., Newburyport, Mass. 01950. [Circle 351]

256-K CMOS ROM runs without a clock

Silicon-gate CMOS technology is behind the low power requirements and minimal heat dissipation of this 256-K ROM. The 23C256 needs only a single 5-V power supply and operates on 40 mA (100 μA in standby mode). The ROM, organized as 32-K words by 8 bits, has an access time of 150 ns. It is fully TTL-compatible; also, because of its static (asynchronous) operation, the 23C256 requires no clock.

The chip has applications throughout the industry, the manufacturer says, including in office-automation products and telecommunications systems. The 23C256 comes in a 28-pin DIP, with an industry-standard, byte-wide Jedec pinout. In 10,000-unit quantities, the chip is priced at $6.50 each. Samples are available now, but large orders need a lead time of six weeks.

NCR Corp., Microelectronics Division, 8181 Byers Rd., Miamisburg, Ohio 45342.
Phone (800) 543-5618 [in Ohio, (513) 866-7217] [Circle 355]

Ripple mode lets RAM access data in 50 ns

Pin-compatible with standard n-MOS 64-K dynamic RAMs, this manufacturer's 51C64 64-K-by-1-bit CMOS DRAM is compatible with Intel's 51C64 chip. In Ripple-mode, the 51C64 will randomly access any bit within a 256-bit page in 50 ns. In normal operation, 80% of memory accesses are within the page boundary, so that system access takes an effective time of 80 ns.

The manufacturer recommends this CMOS DRAM for such applications as mainframe memory, image processing, and graphics terminals. Its power dissipation suits it for board-level monitoring systems—such as robotics or pipeline monitoring and control—in industrial environments.

In quantities of 100, the 51C64's price is $9.95 each. The first production quantities are scheduled to begin shipping late in the first quarter of 1985.

Vitelic Corp., 4701 Patrick Henry Dr., Suite 1702, Santa Clara, Calif. 95054. Phone (408) 727-2206 [Circle 356]

Audio test system uses computer for fast results

A personal-computer-based audio test system performs standard tests 3 to 10 times faster than its fastest competitors, the manufacturer says.

The System One can automatically run nearly all common audio tests: users select the desired test from a menu, and results are graphed automatically as the test is made. The modular system works with an IBM Corp. Personal Computer or compatible.

The company, a startup formed by four former Tektronix engineers and managers, claims its first product sets new standards for automated or semiautomated test equipment in residual noise (less than 1.5 mV), distortion (less than 0.001%), level measurement accuracy (0.1 dB), generator output level (26.6 V open circuit, +30 dB into 600 Ω), and flatness (0.05 dB).

A typical configuration of the System One, including all software, a high-level balanced generator, and measurement modules for level, frequency, noise, and harmonic distortion, sells for $5,225. The user can add a variety of options and modules. Delivery takes about 10 weeks from receipt of order.

Audio Precision Inc., P.O. Box 2209, Beaverton, Ore. 97075.
Phone (503) 297-4837 [Circle 353]

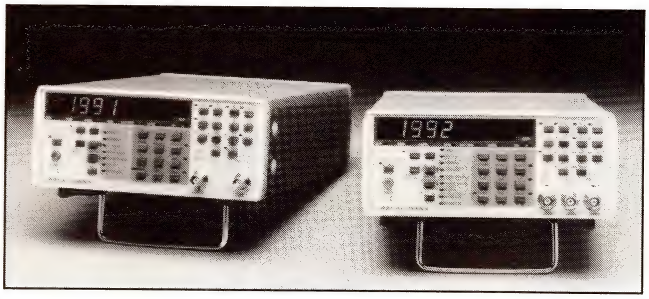
Universal counter offers nine-digit readouts in 1 s

Relying on a microprocessor and a set of custom large-scale ICs, the 1992 universal counter provides up to nine digits of frequency resolution in just 1 s at all frequencies.

The 1.3-GHz counter's resolution can be reduced for faster measurements or for a clearer display when monitoring noisy or unstable signals. Thanks to a high-speed counting circuit and a time-error correction circuit, the device's 10-MHz clock gives performance usually associated with a 1-GHz clock universal counter—a 1-ns single-shot time interval.

The 1992 provides a full range of manual- and automatic-trigger control features. Autotrigger, direct trigger voltage entry, and up and down slew controls enable both casual and practiced users to determine and set triggering parameters.

A stop/delay feature for use in avoiding mistriggering



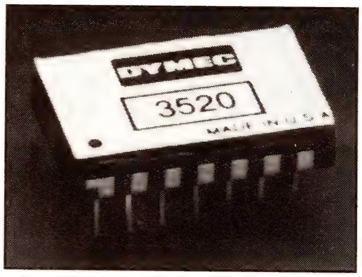
on ringing or bouncy contact signals is also included, as is a set of additional functions accessed with a special function key. Those functions are one-shot autotrigger, manual start/stop totalize, and a number of self-test and diagnostic features.

The 1.3-GHz 1992 sells for $1,395; a 160-MHz model, the 1991, is available for $1,095. An optional rechargeable battery pack is $350. The systems and other options are available now.

Racal-Dana Instruments Inc., 4 Goodyear St., Irvine, Calif. 92718.
Phone (714) 859-8999 [Circle 354]

Thin-film technology boosts op amp's precision

Radar processing, video instrumentation, and high-speed test equipment are the favored applications for the series 3520 wideband operational amplifier. This op amp features a 250-ns settling time (maximum) along with a gain-bandwidth product of 450 MHz. The slew rate is 350 V/μs, and offset voltage is ±1 mV.

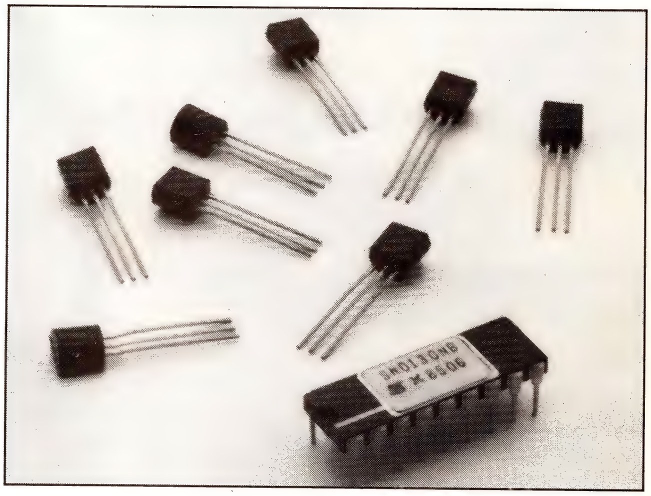


The 3520 is a full-differential FET-input part that uses thin-film and laser-trim technology for precision tracking and tight control on dc parameters. Pin material and plating composition conform to method 2003 (solderability) of MIL-STD-883; packaged in a standard 14-pin DIP, of either metal or ceramic, the 3520 op amp is priced at $97 in hundreds quantities. Delivery takes approximately four weeks after receipt of order.

Dymec, 8 Lowell Ave., Winchester, Mass. 01890.
Phone (800) 225-1151 or (617) 729-7870 [Circle 361]

Darlington arrays target speed, high-voltage needs

Diffused-MOS technology for ultrahigh gain is used in the manufacture of a series of Darlington arrays. The eight-channel devices are intended by the manufacturer for such applications as electrostatic printers, electroluminescent and plasma displays, and ultrasonic transducer drivers—applications where low losses, low component count, speed, and high voltage are important.



Among the specifications for the SNO140NB array are a breakdown voltage of 400 V, on-resistance of 350 Ω, and a drain current of 51 mA. The 300-V SNO130NB and 100-V SNO120NB feature on-resistances of 300 Ω and a 55-mA drain current.

Each of the arrays features common sources, analogous to common emitters in an npn array. Moreover, each is pinned out for easy circuit layout in byte-wide systems, with the gates on pins 1 to 8 and the corresponding drains on pins 18 to 11.

The arrays are packaged in an 18-lead, side-brazed ceramic package for automated insertion. All three are available now, and prices (in quantities of 250 to 999) range from $9.10 to $12.15 each.

Siliconix Inc., 2201 Laurelwood Rd., Santa Clara, Calif. 95054.
Phone (408) 988-8000 [Circle 360]

Local-area network bucks proprietary protocols

Open protocols—ones that are publicly available—are the foundation of OpenNet, a local-area network that supports dissimilar operating systems in contrast to proprietary protocols that restrict the vendor's choice of equipment. Intel, which supports OpenNet, has unveiled four network products.

Joining computers and operating systems from different manufacturers on a single network, OpenNet addresses all seven layers of the International Organization for Standardization's network reference model with the following subsystems: the iRMX and Xenix networking software packages handle the upper layers—layers five through seven. Layers three and four are represented by iNA 960, software based on the ISO's 8073 transport standard.

Layers one and two are supplied by the iSBC 552 COMMengine board. The iSXM 552 transport engine board incorporates a preconfigured version of iNA 960 and thus supplies layers one through four. Both communications boards are based on the Ethernet standard (IEEE 802.3).

The iRMX and Xenix networking software each sup-

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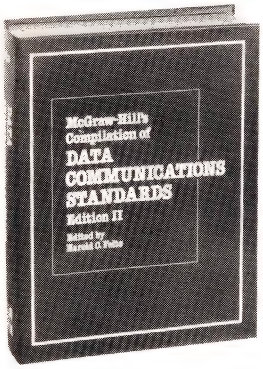
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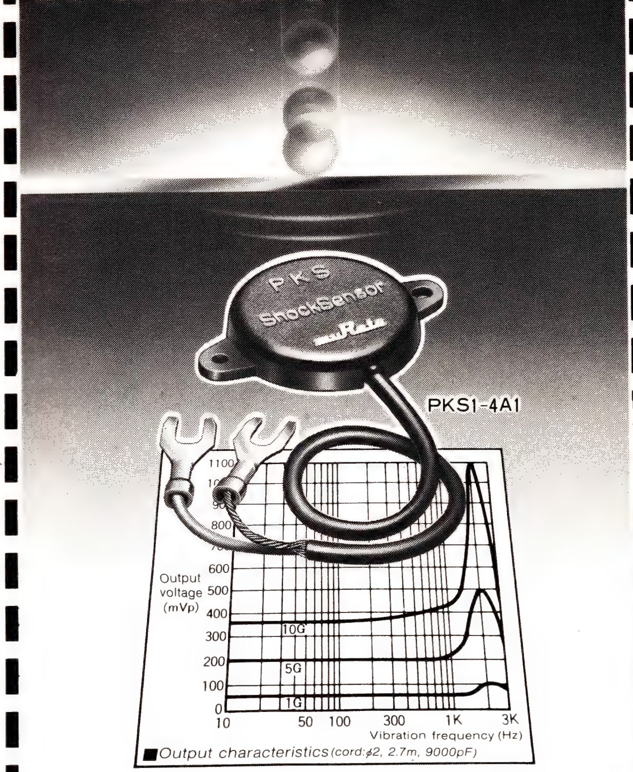

■*Output characteristics* *(cord:ϕ2, 2.7m, 9000pF)*

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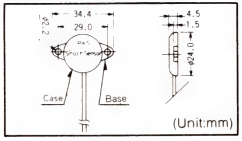
Insulation Resistance	30MΩmin or more (100VDC)
Operating Temp. Range	−20~+60℃
Storage Temp. Range	−20~+70℃
Strength of Lead Wire.	250g for 1min along axis.

■Dimensions(PKS1-4A1)



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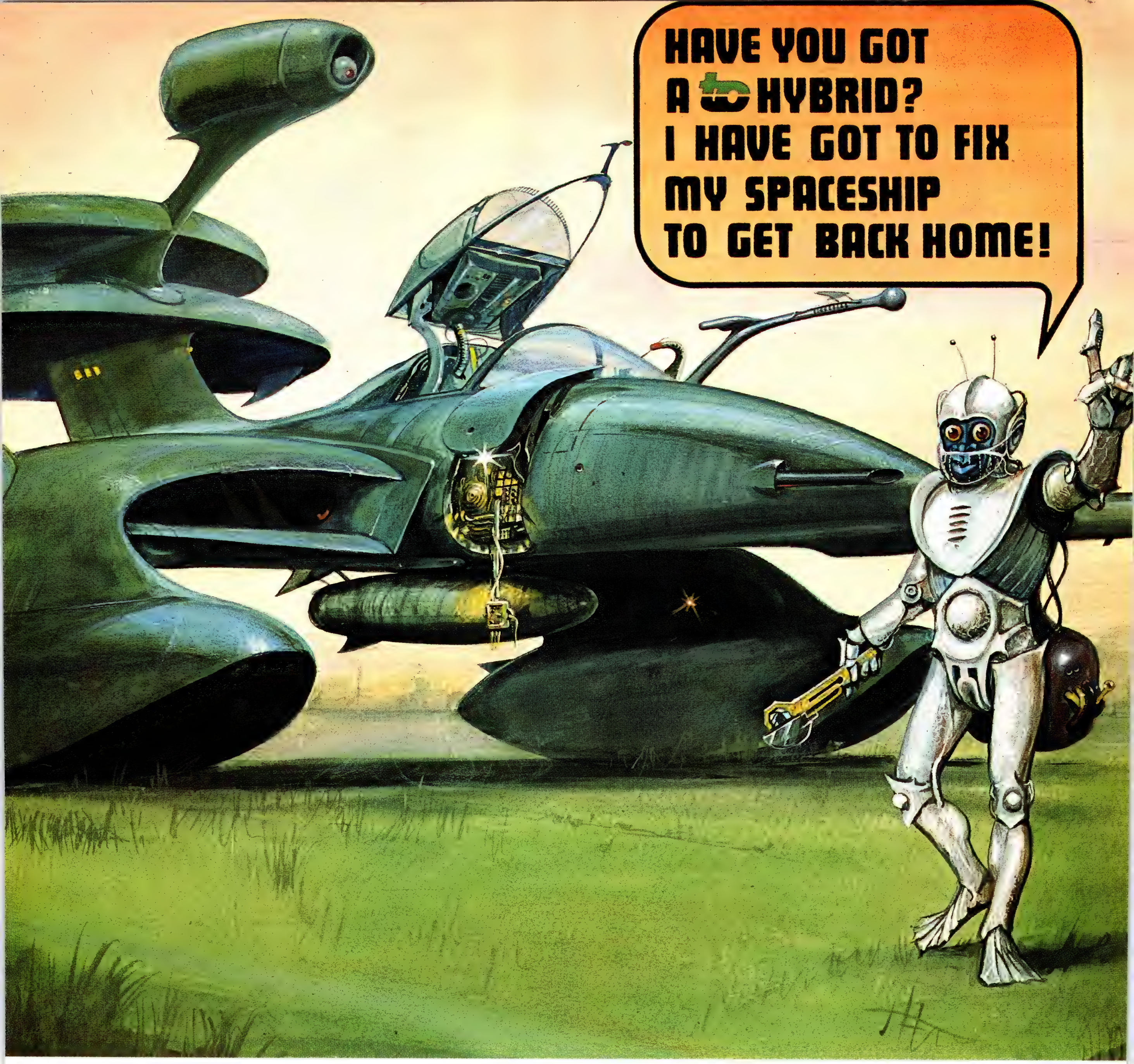
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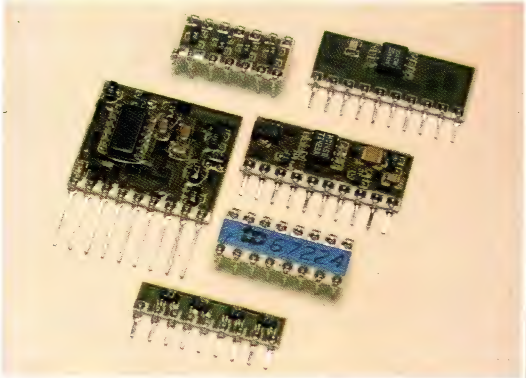

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ply network file access for systems using iRMX, a real-time operating system, and Xenix. In addition to Ethernet, OpenNet will eventually support General Motors Corp.'s Manufacturing Automation Protocol.

These OpenNet products are available this month at the following prices: iSBC 552 COMMengine board, $1,500; iSXM 552 transport engine board, $1,800; iRMX networking software, $9,500; and Xenix networking software, $9,500 (including manufacturer license).

An unbundled version of the transport engine board without transport-layer software, model SBC 552, lets original-equipment manufacturers load their own versions of the network programs into the board's RAM for specialized applications. This board sells for $1,500 and is available in two weeks.

Intel Corp., 3065 Bowers Ave., Santa Clara, Calif. 95051.
Phone (408) 987-7219 [Circle 362]

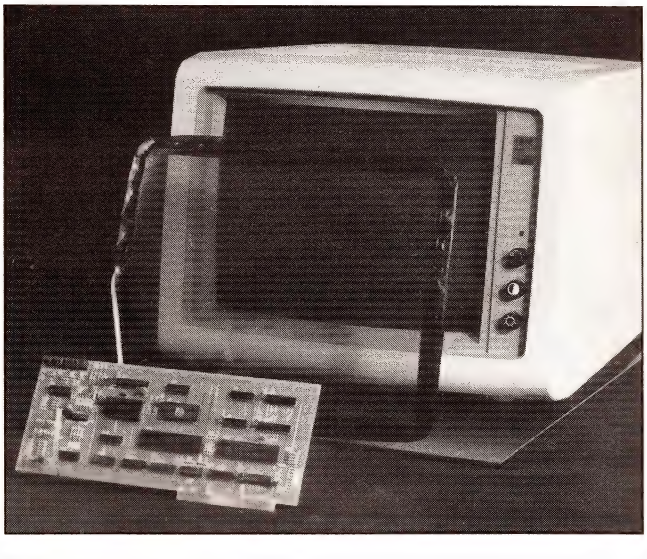
Display monitor system yields to user's touch

An analog touch-sensitive monitor system, PC Touch, runs on the IBM Corp. Personal Computers or compatibles. The system consists of the analog screen and software; all electronic controls fit onto a single plug-in board. With PC Touch, a touch of the user's finger brings a conductive Mylar surface into contact with the glass screen. An electronic controller measuring the location of the touch point then relays the point's X and Y coordinates to the computer.

The software lets the user select either single-point or continuous-screen input, create custom touch zones, and design overlay menus. PC Touch also provides touch-screen cursor control on Microsoft-compatible software.

Industrial process controls, retail point-of-sale terminals, and tourist-information kiosks are some of the applications for PC Touch. An RS-232-C interface is available in certain configurations. Also, a system is available that lets nonprogrammers write touch-applications software for both the IBM PC and the Apple II.

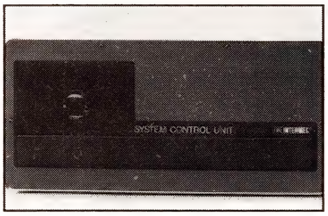
The price of PC Touch, which varies with the monitor chosen, begins at $895; the control board, software, and screen adapter are available without the sensor for $249; quantity discounts are offered.



Touch Technology Inc., 107 Gibralter St., Annapolis, Md. 21401.
Phone (301) 269-6181 [Circle 363]

Bar-code controller works with IBM mainframes

IBM Corp. mainframes are the exclusive beneficiaries of the bar-code control unit, the model 9165. With it, IBM mainframe users can control bar-code readers, printers, and terminals through as many as 16 ports. ASCII terminals and printers can also function through the 9165 controller, without any IBM host software changes.



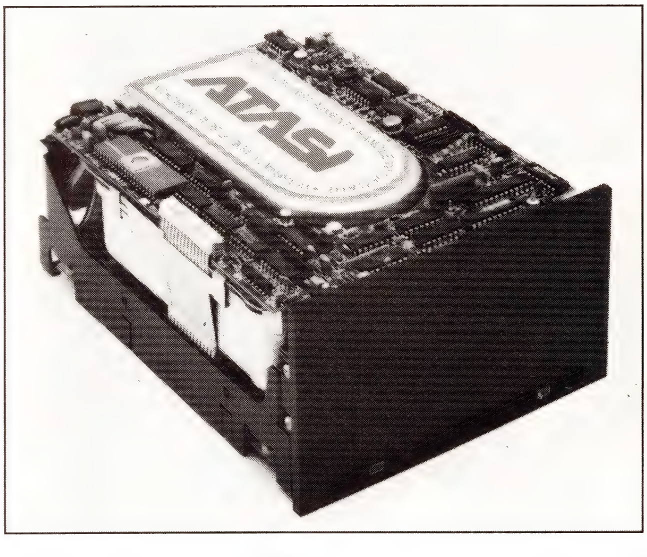
When IBM's Systems Network Architecture/Synchronous Data Link Control interactive devices are emulated, they appear to the IBM mainframe as standard 3270-type terminals. When Interactive Reader Language is used with the 9165, complete IBM 3278 screens may be transmitted and received.

Two interfaces are available—RS-232-C, which can transmit data at a 19,200-b/s clip, and RS-422, which permits Intermec readers and printers to be located up to 4,000 ft away from the control unit. In single quantities, the 16-port model 9165 bar-code control unit is priced at $9,800. Shipments will begin at the end of this month.

Intermec Corp., 4405 Russell Rd., P.O. Box 360602, Lynnwood, Wash. 98046. Phone (206) 348-2600 [Circle 364]

Memory kit upgrades PC AT's hard-disk storage

Forty-two megabytes of additional hard-disk storage can be accessed in 33 ms on the IBM Corp. Personal Computer AT with AT SpeedStor, an internal-memory-up-



grade kit. Based on the 51-megabyte model 3051 5¼-in. Winchester disk drive from the same manufacturer, AT SpeedStor includes proprietary software that requires no modification to existing hardware, follows all of the PC-DOS rules, and boots directly from the drive.

The plug-and-play kit, which also includes the data cable, mounting hardware, and an instruction manual, can be installed in 30 min, the manufacturer says. The suggested retail price of the AT SpeedStor kit is $2,495, with shipping time of 30 days for quantity orders.

Atasi Corp., 2075 Zanker Rd., San Jose, Calif. 95131.
Phone (408) 995-0335 [Circle 365]

Computer controllers are IBM plug-compatible

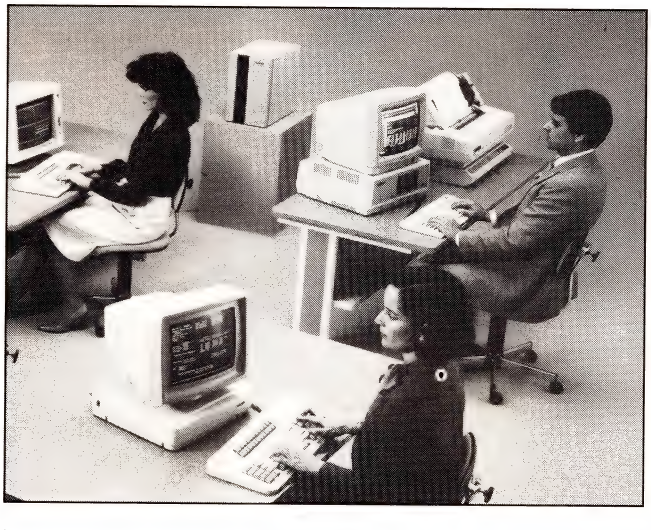
A system of local and remote controllers that are plug-compatible with IBM Corp.'s 3270 supports virtually the full range of IBM 3270 and Harris Corp. terminals and printers. Before the Challenger information display system, Harris systems have been only functionally compatible with the IBM world.

Challenger supports both local and remote configurations in IBM System Network Architecture/Synchronous Data Link Control or Binary Synchronous Communications protocols. Remote communication speeds range from 1.2 to 56 kb/s, in either half or full duplex.

Consisting of floor-model local controllers and desktop remote controllers that support a variety of devices, the system can be installed by the user. Each controller can support up to 32 devices. ASCII devices, such as desktop printers and displays, can be connected to the Challenger controllers through the ASCII support feature; IBM and Harris personal computers can be connected either directly or through dial-up capability.

A typical configuration might include a remote controller, 12 displays, and 2 printers, for a total price of $39,600. A larger system, consisting of a local controller, 24 terminals, and 4 printers, would sell for about $84,600. Initial system configurations are available now.

Harris Corp., Information Terminal Group, 1601 Dallas Pkwy., Dallas, Texas 75380. [Circle 352]



19,200-baud modem has internal multiplexer

Transmission rates of 19,200 b/s are possible over leased voice-bandwidth telephone lines with the DSP 19200M data modem. The modem features a built-in eight-port data multiplexer, comprehensive diagnostic testing, and error correction. It measures 12.4 by 15.4 by 3.5 in.

The 19200M uses digital signal-processing chips developed by the company. Operational options can be downline-loaded to remote modems connected to a multipoint telephone line. Diagnostic tests include addressable analog and digital loopbacks and bit error-rate and polling tests, with error-count displayed on the front of the modem at the central site.

The modem can also operate at data rates of 16,800, 14,400, 12,000, and 9,600 b/s, or it can operate asynchronously using the optional asynchronous-to-synchronous converter. The device operates over four-wire type-3002 leased telephone lines with D1 conditioning. Available in June 1985, the 19200M modem sells for $12,000.

NEC America Inc., 1012 Stewart Dr., Sunnyvale, Calif. 94086.
Phone (408) 737-7711 [Circle 371]

Flexible robot lifts 220 lb at 9-ft extension

With six axes of movement, the GCA/DK B3200 robot is strong enough to lift 220 lb at its full extension of 9 ft. All-electric dc servodrives on all axes and an automatic counterbalancing system on the arm-articulation axes assure responsive manipulation within the robot's 650-ft^3 work envelope. The robot combines cylindrical and Cartesian coordinate systems.

The company's GCA/DK F200 or Cimroc 2 robot controllers operate the robot; the former provides point-to-point control; Cimroc 2 allows six-axis, simultaneous continuous-path or similar integration.

Handling accessories include mechanical gripper hands, vacuum-cup lifters, magnetic lifters, forklifts, and box lifters. Complete welding systems are also available.

The point-to-point system costs $67,300, and the Cimroc-controlled robot lists for $99,300. Delivery is approximately 120 days after ordering.

GCA Corp., 209 Burlington Rd., Bedford, Mass. 01730.
Phone (617) 275-9000 [Circle 370]

MATERIALS □ SUPPLIES □ ACCESSORIES

A one-component solvent-free epoxy, Ablebond 77-1, was developed specifically for attaching surface-mounted devices to boards before wave solder takes place. The product is applied through a 23- or 26-gauge needle; the manufacturer says the epoxy eliminates postattachment tailing and sagging. Cure time is 3 min at 150°C.

Ablestik Laboratories, 833 W. 182nd St., Gardena, Calif. 90248. Phone (213) 532-9341 [Circle reader service number 421]

Alexandrite laser rods, in demand for their tunability and capable of output for all wavelengths from 700 to 815 nm, are being marketed under the trade name Allexite. The company will grant a nonassignable research and development license in consideration for the purchase price.

Allied Corp., 1201 Continental Blvd., Box 31428, Charlotte, N.C. 28231.
Phone (704) 588-2340 [Circle 422]

RX 640 Phenolic, when used as the body of a DIP adapter, can withstand brief soldering temperatures of between 750°F and 1,100°F, exhibiting little postmold warpage. It is also said to show good pin retention and to withstand a continuous-use temperature of 380°F.

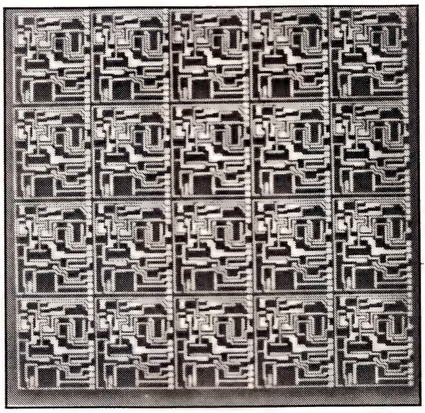
Rogers Corp., Molding Materials Division, Dept. 22, P.O. Box 550, Manchester, Conn. 06040. Phone (203) 774-9605 [Circle 423]

A panel feed-through version of this manufacturer's modular surface-mount terminal strips lets the user choose from among nine options for underside (internal) wiring connections—including wire wrap, solder, or quick disconnects. Centers are 7/16 in. for retrofit to existing barrier-strip designs, and angled or short straight-pin versions may be used as pc-solderable connectors. The product is modular, and color coding is possible. External wiring is by the manufacturer's patented "cage-clamp" wire clamp.

Wago Corp., 6657 N. Sidney Pl., Milwaukee, Wis. 53209. Phone (414) 352-1035 [Circle 425]

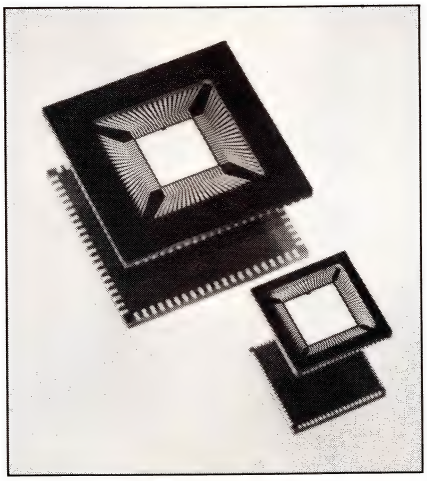
A polymer thick-film conductor formulated for solder-coating use and compatible with wave or dip soldering, polymer-nickel 2548 can be used with type FR-4 substrates. Ten-mil lines and spaces can be resolved using a 200- to 250-mesh stainless-steel screen. Adhesion is greater than 6 lb pull strength when tested on a 100-by-100-mil pad. Cure schedule is 30 min in a convection oven or 5 min in a furnace at 165°C.

Rohm & Haas Advanced Materials Co., 609 Center Ave., Mamaroneck, N.Y. 10543. Phone (914) 698-8434 [Circle 428]



Glass epoxy leadless chip carriers with a footprint pitch of 0.025 in. boast substantial real-estate savings over the standard 0.50-in. chip carrier. Compared in the photo are the model 84-50 (top) and the smaller model 84-25, showing the bottom footprint as well as the top cavity area. The FR-4 glass epoxy guarantees a perfect thermal coefficient of expansion match to standard pc boards, the manufacturer says. Models for 44, 68, 84, and 132 terminations on the 25-mil footprint are available in up to six weeks' delivery time, depending on the quantity ordered. Most special configurations can be produced in 10 to 12 weeks, for a total tooling cost of $2,000.

SA Communications, 5482 Complex St., Suite 113, San Diego, Calif. 92123. Phone (619) 292-1604 [Circle 431]



A 16-slot STD-bus card cage with top-mounted switching supply, the QMB16.5PS5 can be used alone or mounted on a table or a 19-in. EIA rack. It accommodates two 3½-in. floppy-disk drives. All signal lines are passively terminated so that no terminator cards are needed and to reduce electromagnetic interference. Other features include power-supply-transient protection to 1.5 kV and power-supply-overvoltage protection. The design of the card cage lets heat rise and creates autoconvection cooling. Priced at $468 for original-equipment-manufacturer quantity orders, the card cage can be delivered within 30 days.

Computer Dynamics Inc., 105 S. Main St., Greer, S.C. 29651. Phone (803) 877-7471 [Circle 426]

Silver conductive epoxy adhesive, Polymer System EP77, is formulated for minimal ionic and other impurity levels and is dimensionally stable over a temperature range of –60°F to +300°F. Bonding similar and dissimilar substrates easily, it has a shelf life of better than six months. Applications for the electronics industry include bonding components to printed-circuit boards, antenna bonding, lead attachments, and rf shielding.

Master Bond Inc., P.O. Box 522, Teaneck, N.J. 07666.
Phone (201) 343-8983 [Circle 429]

Solvents are not used in this two-part silver-filled epoxy, making it especially suitable for applications in flexible circuitry—for which it was designed—and in chip bonding, where temperatures run above 250°C. Epo-Tek H20F can be applied by screen printing, stamping, and roller-coating techniques, and it mixes in a 1:1 ratio.

Epoxy Technology, P.O. Box 567, Billerica, Mass. 01821. Phone (800) 227-2201 [in Massachusetts, (617) 667-3805] [Circle 430]

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May 20	Gallium Arsenide Integrated Circuits
May 27	Computer Graphics Trends

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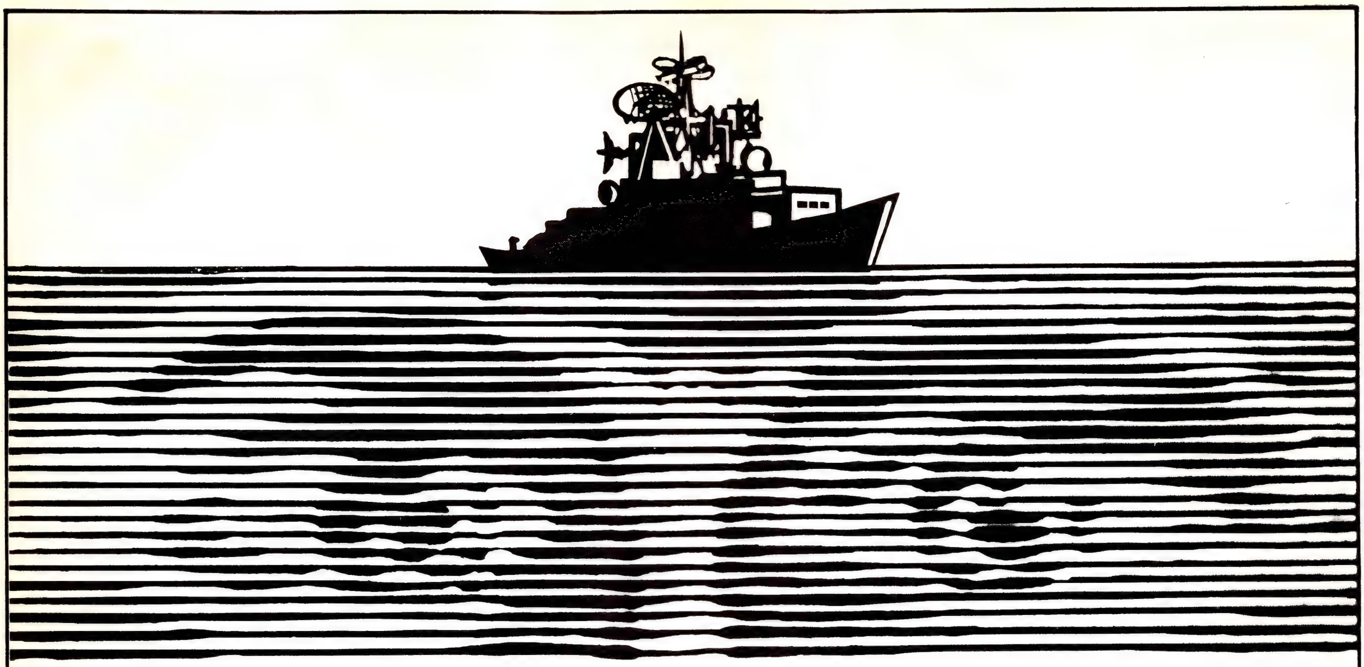

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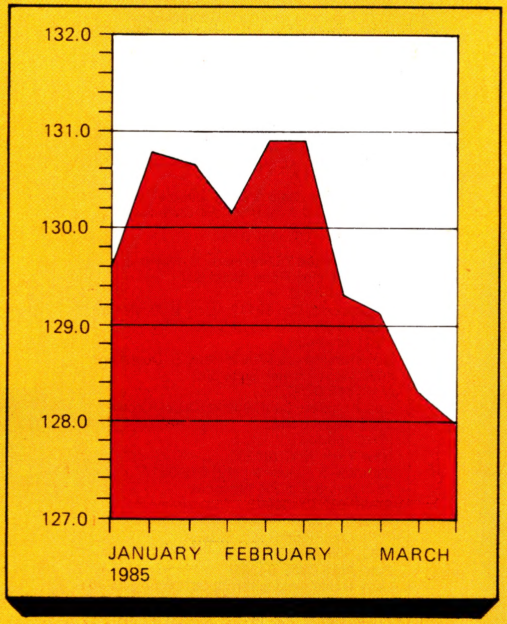
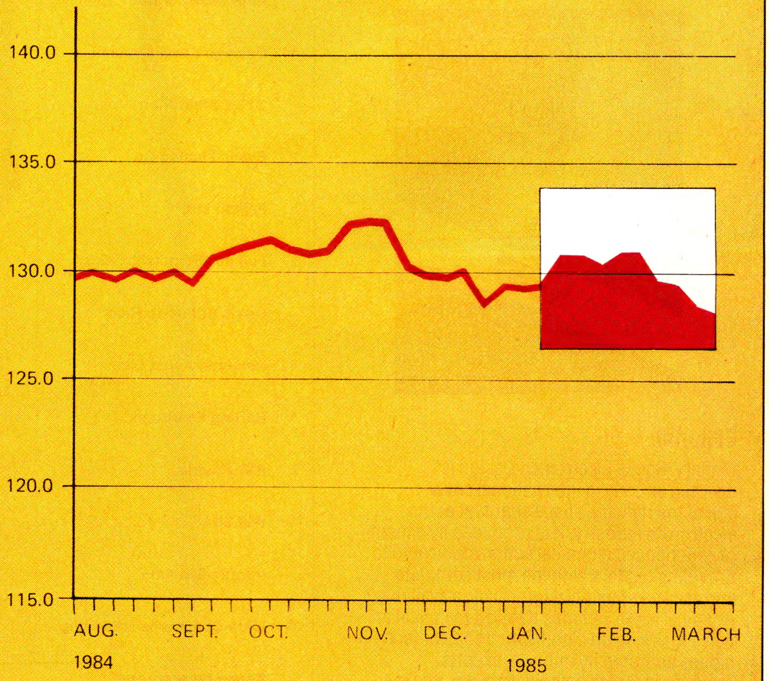
ElectronicsWeek Index



THIS WEEK = 128.0
LAST WEEK = 128.3
YEAR AGO = 124.0
1982 = 100.0



The *ElectronicsWeek* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear from week to week.

U.S. ELECTRONICS IMPORTS AND EXPORTS (MILLIONS OF DOLLARS)

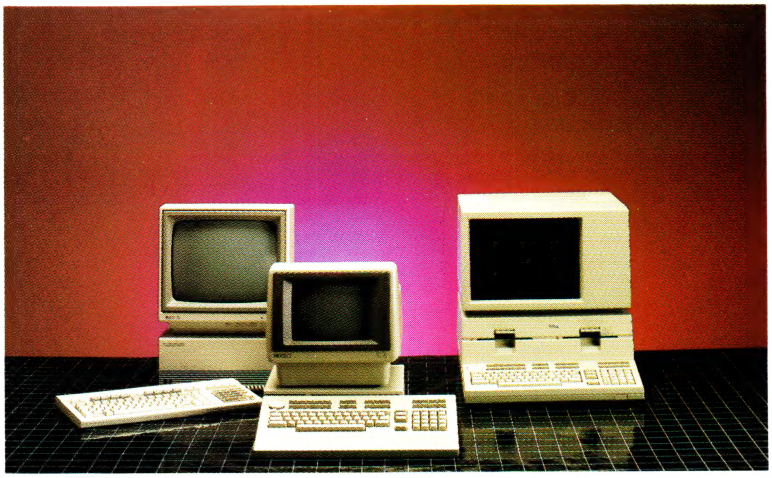
	IMPORTS			EXPORTS		
	January 1985	December 1984	January 1984	January 1985	December 1984	January 1984
Accounting, computing, and data-processing machines	416.511	348.867	309.192	669.750	701.455	475.273
Calculators	67.697	56.729	63.435	8.066	9.726	8.685
Parts for data-processing machines and office calculators	392.508	433.021	372.093	611.387	644.621	414.473
Telecommunications, sound-recording, and sound-reproducing equipment	1,741.332	1,593.404	1,209.557	361.749	394.334	360.602
Electronic or electric instruments	131.984	144.992	123.238	567.128	619.765	458.558
Printed-circuit boards	21.428	25.742	18.831	28.822	27.734	18.131
Integrated circuits, diodes and other semiconductors, tubes, piezoelectric crystals, parts	630.816	822.832	597.938	527.050	572.517	418.289
Fixed and variable resistors	23.364	30.833	25.100	15.117	18.541	15.356

An 8% slide in exports of U.S.-made electronics equipment in January touched off a slight decline in the *ElectronicsWeek* Index for the latest week. Imports were kept at bay, but the decline in exports increased the overall trade deficit in electronics equipment by 52%. Nevertheless, January's rise in the deficit was slight compared with the 500% advance the month before. Exports of U.S. electronics goods fell across all product lines except circuit boards—a sign, perhaps, that U.S. firms are stepping up offshore manufacturing operations. Month-to-month changes in imports were mixed: accounting and calculating equipment imports rose 19%, while semiconductors and resistor imports fell 25%.

FOUR MEGABYTES ON ONE BOARD

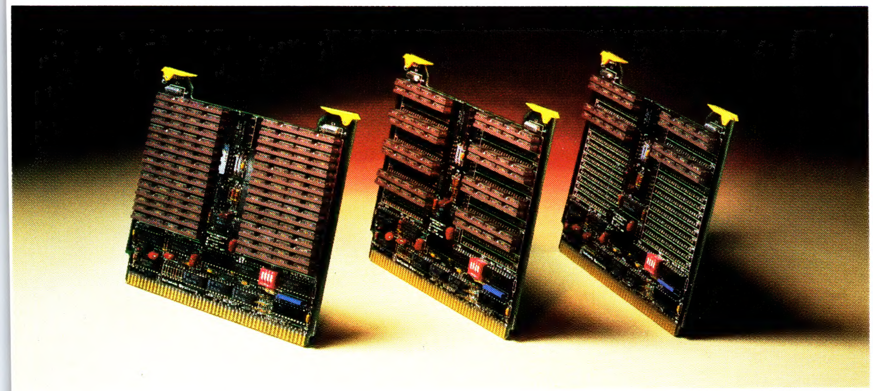
Give your Hewlett-Packard Series 200 computers the Infotek Advantage...

...up to four megabytes on a single board.



Pictured right: HP 200 Series Computers 217, 216, 236.

Pictured left to right: AM 244 (4MB), AM 242 (2MB), AM 241 (1MB)



INFOTEK: Infotek has been supplying HP enhancement products to Fortune 1000 companies for almost ten years.

SINGLE BOARD SOLUTIONS: Your HP 9816 computer can now be configured with 1MB, 2MB or 4MB of memory in a single slot.

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COMPLETE COMPATIBILITY: All Infotek memory boards are 100% compatible with HP memory boards.

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UNMATCHED RELIABILITY: Infotek boards are tested for seven full days in HP 200 Series computers. Our record of better than 99% reliability speaks for itself.

WARRANTY—TWO YEARS: Infotek hardware products are backed by the best warranty available. Two solid years.

AFFORDABLE PRICE: All Infotek products are priced to save you money. And we offer the best discounts to volume and OEM customers on top of our affordable prices.

AM 200—1MB Memory: **$2,575**
AM 241—Upgradeable: **$3,750**
AM 242—Upgradeable: **$5,950**
AM 244—Fully populated: **$10,750**
UK 212—Upgrade: **$2,400**

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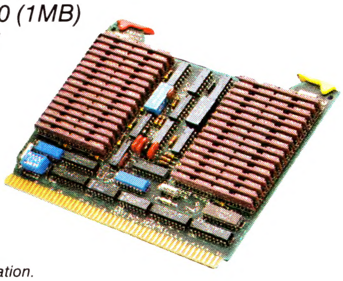
So before you order your next memory boards, call Infotek and compare. OEM, government, educational and quantity discounts available.

Pictured: AM 200 (1MB) Memory



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